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NATIONAL DAM SAFETY PROGRAM. LAUCK LAKE DAM (MO 40068), MISSISS--ETC(U)
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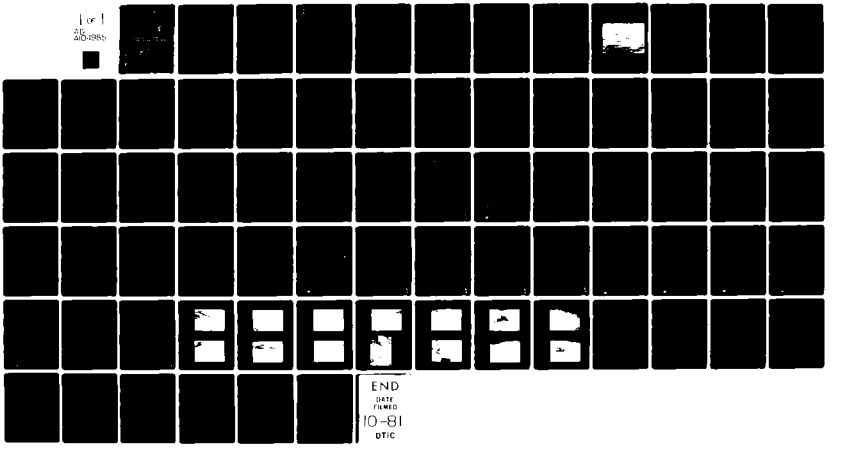

LEVEL I

MISSISSIPPI-ST. FRANCIS RIVER BASIN

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LAUCK LAKE DAM
SCOTT COUNTY, MISSOURI
MO 40068

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PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

United States Army
Corps of Engineers
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St. Louis District

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PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

MARCH 1981

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19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)* Dam Safety, Lake, Dam Inspection, Private Dams		
20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)* This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.		

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 TUCKER BOULEVARD, NORTH
ST. LOUIS, MISSOURI 63101

REPLY TO ATTENTION OF

SUBJECT: Lauck Lake Dam (MO 40068)
Scott County, Missouri
Missouri Inventory No. 40068

This report presents the results of field inspection and evaluation of Lauck Lake Dam (MO 40068). It was prepared under the National Program of Inspection of Non-Federal Dams.

SIGNED

SUBMITTED BY: _____ 10 JUN 1981
Chief, Engineering Division — Date

APPROVED BY: SIGNED _____ 11 JUN 1981
Colonel, CE, District Engineer — Date

MISSISSIPPI-ST. FRANCIS RIVER BASIN

LAUCK LAKE DAM
SCOTT COUNTY, MISSOURI
MISSOURI INVENTORY NO. 40068

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Prepared By

Crawford, Murphy & Tilly, Inc., Springfield, Illinois
A & H Engineering Corporation, Carbondale, Illinois

Under Direction Of

St. Louis District, Corps of Engineers

For

Governor of Missouri

MARCH, 1981

PREFACE

This report is prepared under guidance contained in Department of the Army, Office of the Chief of Engineers, Recommended Guidelines for Safety Inspection of Dams, for a Phase I investigation. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general conditions of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigation, testing and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. Additional data or data furnished containing incorrect information could alter the findings of this report.

It is important to note that the condition of the dam depends on numerous and constantly changing internal and external conditions and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

PHASE I INSPECTION REPORT
NATIONAL PROGRAM OF INSPECTION OF NON-FEDERAL DAMS

Name of Dam:	Lauck Lake Dam
State Located:	Missouri
Inventory Number:	MO 40068
County Located:	Scott
Stream:	Unnamed Tributary to Hindman Creek
Date of Inspection:	3 December 1980

BRIEF ASSESSMENT:

Lauck Lake Dam was inspected by a team of engineers from Crawford, Murphy & Tilly, Inc. of Springfield, Illinois and A & H Engineering Corporation, of Carbondale, Illinois. The purpose of this inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers, and they have been developed with the help of several Federal and State agencies, professional engineering organizations and private engineers.

Lauck Lake Dam is an earthfill embankment constructed in autumn of 1977 across an unnamed tributary to Hindman Creek. The dam and lake are located on property owned by the Elks Lodge, B.P.O.E. No. 1810 of Chaffee, Missouri. The lake is also referred to as the Elks Lodge Lake but will be referred to as Lauck Lake in this report. The lake is used for recreation.

Based on the guidelines, the St. Louis District, Corps of Engineers has determined that this dam is in the high hazard potential classification, which means that loss of life and appreciable property loss could occur if the dam fails. The estimated damage zone extends approximately two miles downstream of the dam. Located within this zone are five or more dwellings and several farm buildings. The dam is in the small size classification due to its height of 33.4 feet and maximum storage capacity of 62 acre-feet. A small size dam has a height greater than 25 feet but less than 40 feet and/or a maximum storage capacity greater than 50 acre-feet but less than 1,000 acre-feet.

Our inspection and hydrologic and hydraulic analyses indicate that the spillway capacity of the dam approximately meets the criteria set forth in the guidelines for a dam having the above size and hazard potential. The dam will hold and pass approximately 50 percent of the Probable Maximum Flood (PMF) with only minor overtopping. The Probable Maximum Flood is defined as the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The guidelines require that a dam of small size with a high downstream hazard potential pass 50 percent to 100 percent of the PMF. The dam has a relatively

small capacity of 62 acre-feet and a small drainage area of 35 acres. The downstream flood plain becomes relatively wide approximately 0.2 miles downstream from the dam and the nearest dwelling in the hazard zone is approximately 0.5 miles downstream from the dam. Considering these facts, 50 percent of the PMF has been determined to be the appropriate spillway design flood. Although a minor amount of overtopping will occur during the 50 percent PMF event, (approximately 1 inch maximum depth of overtopping with a duration of 15 minutes as determined by the HEC-1 computer program) it appears that this minor overtopping is unlikely to cause dam failure since the dam is in good condition. The dam approximately passes the recommended spillway design flood, therefore the spillway capacity of this dam is considered adequate. The 1 percent probability flood (100-year flood) will not overtop the dam. The 1 percent probability flood is one that has a 1 percent chance of being equalled or exceeded in any given year.

The dam appears to be in good condition. Several deficiencies were noted during the inspection. There was minor erosion on the downstream face of the dam and sparse vegtal cover at several locations on the dam and in the emergency spillway channel. Holes from burrowing animals were found on the downstream face of the dam. Another deficiency is the lack of seepage and stability analysis records.

It is recommended that the owners take the necessary action in the near future to correct the deficiencies reported herein. A detailed discussion of these deficiencies is included in the following report.

Nathan Wilcoxon

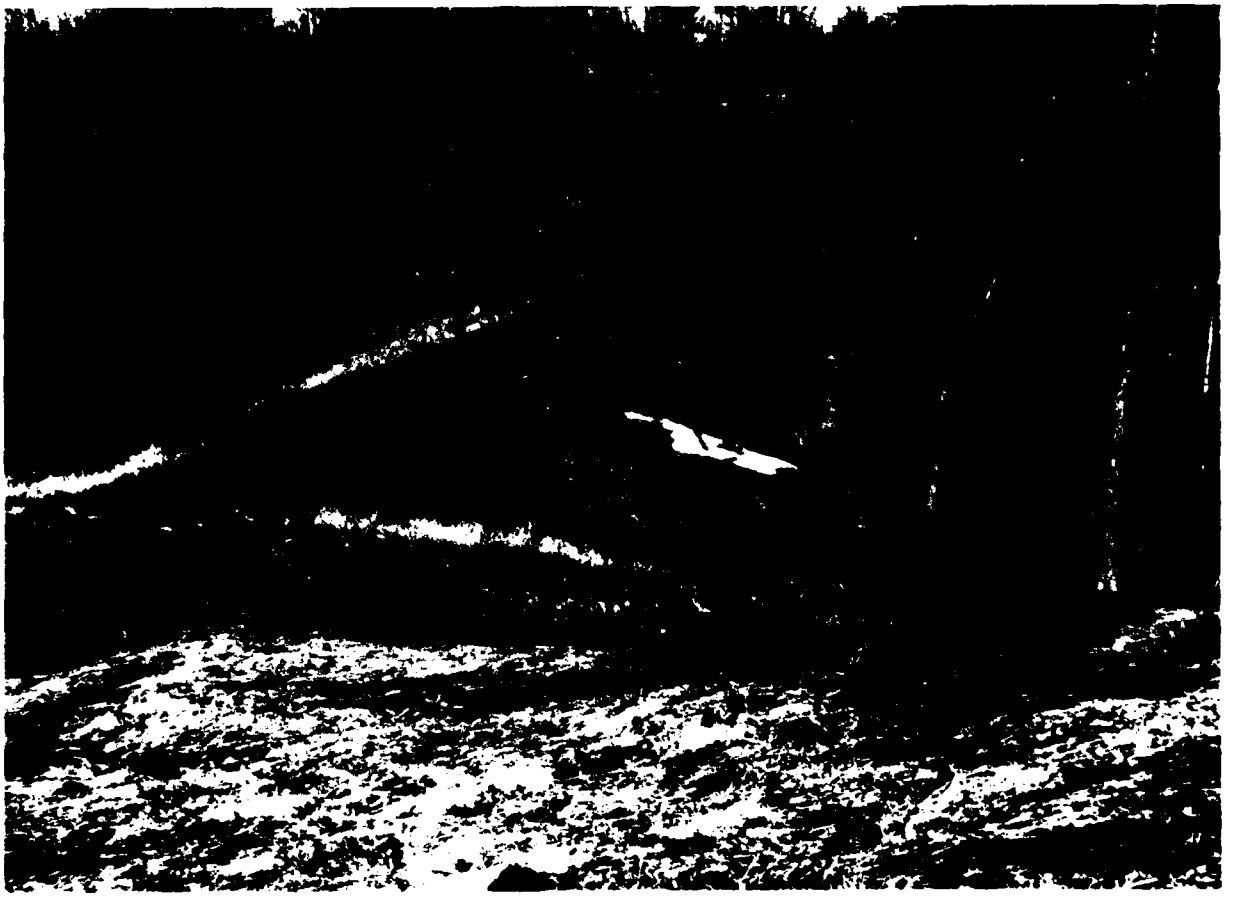
Nathan Wilcoxon, P.E.
Crawford, Murphy & Tilly, Inc.

Guy Freese

Guy Freese, P.E.
A & H Engineering Corporation

Timothy P. Tappendorf

Timothy P. Tappendorf, E.I.T.
Crawford, Murphy & Tilly, Inc.



PHOTOGRAPH 1. OVERVIEW OF LAUCK LAKE DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
LAUCK LAKE DAM
MISSOURI INVENTORY NO. 40068

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APPENDICES

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL:

A. Authority:

The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection be made of Lauck Lake Dam located near Chaffee, Missouri, in Scott County.

B. Purpose of Inspection:

The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and a visual inspection in order to determine if the dam poses hazards to human life or property.

C. Evaluation Criteria:

Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, Recommended Guidelines for Safety Inspection of Dams. These guidelines were developed with the help of several federal agencies and many state agencies, professional engineering organizations, and private engineers.

1.2 DESCRIPTION OF PROJECT:

A. Description of Dam and Appurtenances:

Lauck Lake Dam is an earthfill structure approximately 33.4 feet high and 250 feet long at the crest. The principal spillway is a 6 inch diameter ungated smooth steel pipe with a trash rack on the upstream end. The pipe slopes through the embankment and discharges just beyond the toe of the embankment. There is a trapezoidal emergency spillway channel cut into natural ground just right of the right abutment. In this report right and left orientation are based on looking in the downstream direction. There is a drawdown facility consisting of a 4 inch diameter PVC Schedule 40 plastic pipe with a gate valve that is operated at a valve box located near the downstream end.

B. Location:

The dam is located about 1 mile east of Chaffee, Missouri in Scott County, on an unnamed tributary to Hindman Creek. The longitude of the dam is 89° 37.8' west and the latitude is 37° 10.8' north. The dam and its watershed are located within Section 16 of Township 29 North, Range 13 east of the 5th Principal Meridian. Included in Appendix A are a location map for the dam on Plate 1 and a vicinity map on Plate 2.

C. Size Classification:

Lauck Lake Dam has an embankment height of approximately 33.4 feet and a maximum storage capacity of 62 acre-feet. Therefore, the dam is in the small size category.

D. Hazard Classification:

The St. Louis District, Corps of Engineers, has classified this dam as a potential high hazard dam. The estimated damage zone extends approximately two miles downstream of the dam. Located within this zone are 5 or more dwellings and several farm buildings. The affected items in the damage zone were verified by the inspection team.

E. Ownership:

The dam is owned by B.P.O.E. Elks Lodge 1810, 120 East Yoakim, Chaffee, Missouri 63740, telephone 314-887-8993. Mr. Joe Bollinger was the secretary for Elks Lodge at the time of the inspection.

F. Purpose of Dam:

The dam and lake were constructed for recreation. The lake is used primarily for fishing.

G. Design and Construction History:

The dam was designed by the United States Department of Agriculture Soil Conservation Service of Scott County, Missouri. The dam was constructed in September and October of 1977 by Schlosser Construction Company of Benton, Missouri. According to Elks Lodge members, Richard Stiemle and Joe Bollinger, there was a rainfall of about 6 inches soon after construction which caused the principal spillway pipe to wash out. The pipe was repaired by the contractor at that time.

According to William Schlosser of Schlosser Construction Company, the core trench for the dam was excavated with a backhoe and the fill was placed with a scraper and shaped with a bulldozer. He said that there was a cold spell during construction and that the soil around the principal spillway pipe did not settle very well due to the cold weather. Shortly thereafter a rain caused the lake to fill and flow along the outside of the principal spillway pipe eroded the soil around the pipe and the embankment above the pipe collapsed. Mr. Schlosser said he then installed a new pipe, which also had 3 anti-seep collars, and wetted the fill material around the pipe as it was placed to achieve better compaction around the pipe.

In the spring of 1980 concrete was poured around the inlet end of the principal spillway. In the summer of 1980 a short piece of PVC pipe was added to the downstream end of the drawdown pipe and both the upstream and downstream ends of the pipe were capped.

H. Normal Operating Procedures:

The only operating equipment at the dam is the gate valve on the drawdown pipe. Flows into the lake are passed by the principal spillway pipe and through the emergency spillway channel. There is no schedule of operation or maintenance but someone is hired to mow the grass on the dam periodically.

1.3 PERTINENT DATA:

A. Drainage Area (Acres):	35
B. Discharge at Damsite (CFS):	
Maximum known flood at dam site	unknown
Drawdown facility capacity at maximum pool	1.3 (estimated)
Principal spillway capacity at maximum pool	2.2
Emergency spillway capacity at maximum pool	212
Total spillway capacity at maximum pool	214
C. Elevation (Ft. above MSL):	
Top of dam	468.3
Streambed at downstream toe of dam	434.9
Normal pool	464.0
Principal spillway crest	464.0
Principal spillway outlet invert	431.8
Emergency spillway crest	465.8
Drawdown facility inlet	unknown
Drawdown facility outlet invert	432.9
Pool elevation during inspection, 3 Dec., 1980	457.0
Apparent high water mark	465.1
Maximum tailwater	unknown

D. Reservoir Lengths (Feet):

At top of dam	750
At principal spillway crest	625
At emergency spillway crest	675

E. Storage Capacities (Acre-Feet):

At top of dam	62
At principal spillway crest	42
At emergency spillway crest	50
At pool level during inspection, 3 Dec., 1980	19
At elevation of apparent high water mark	47

F. Reservoir Surface Areas (Acres):

At top of dam	5.4
At principal spillway crest	4.2
At emergency spillway crest	4.7
At pool level during inspection, 3 Dec., 1980	2.6
At elevation of apparent high water mark	4.5

G. Dam:

Type		Earthfill embankment
Length of crest (feet)		250
Height (feet)		33.4
Top width (feet)		12
Side slopes (Horiz.:Vert.)	Upstream	3.0:1
	Downstream	3.0:1
Zoning		None
Impervious core		None
Cutoff trench		Bottom width 10' Side slopes 1:1 Average depth 4'
Grout curtain		None

H. Diversion and Regulating Tunnel:		None
I. Spillway:		
I.1 Principal Spillway:		
Location		75' right of left abutment
Type		Ungated 6" diameter smooth steel pipe through dam with trash rack.
Length (feet)		133
Crest elevation (feet above MSL)		464.0
Outlet elevation (feet above MSL)		431.8
I.2 Emergency Spillway:		
Location		Immediately right of the right abutment.
Type		Excavated trapezoidal grass-lined earth channel.
Crest elevation (feet above MSL)		465.8
Bottom width at crest		10'
Side slopes (Horiz.:Vert.)	Right slope	8:1
	Left slope	5.5:1
Channel U/S of control section		20' at -3.5% slope
Control section		50' at 0.4% slope
Channel D/S of control section		20' at 3.1% slope then natural hillside at 20% slope
J. Regulating Outlets:		
Location		115' right of left abutment
Type		4" diameter PVC Schedule 40 plastic pipe through dam
Length (feet)		210 (estimated)
Access to closure		Gate valve near downstream end of pipe at toe of dam.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN:

Engineering design data was obtained from the Scott County, Missouri USDA Soil Conservation Service (SCS). Their office is in the Oran State Bank Building, Benton, Missouri. Copies of the engineering data obtained are presented in Appendix D.

A. Surveys:

Design surveys were made of the damsite and the lake area by SCS personnel in February, 1975 and in September, 1977. According to the field notes, the dam was constructed between 26 September, 1977, and 5 October 1977. A construction check survey was done on 5 October, 1977.

B. Foundation and Embankment Design:

An engineering geologic report was done on the Lauck Lake area on 23 September, 1977, by John W. Whitfield, Geologist, Applied Engineering & Urban Geology, Geology & Land Survey, Missouri Department of Natural Resources. A copy of the report is shown on Sheet 1 of Appendix D. The embankment design was done by SCS personnel and a copy of the design information is shown on Sheets 2 and 3 of Appendix D.

C. Hydrology and Hydraulics:

Hydrologic and hydraulic computations were also done by SCS personnel and copies are shown on Sheets 2, 4, 5, 6 and 7 of Appendix D.

D. Structures:

The only structures are the embankment itself and the principal spillway and drawdown pipes. Their design is as discussed in Paragraphs B and C above.

2.2 CONSTRUCTION:

According to information obtained from the SCS, the dam was constructed in September and October of 1977 by Schlosser Construction Company of Benton, Missouri. No construction inspection was provided but a post-construction survey was performed.

According to William Schlosser, the core trench for the dam was excavated with a backhoe and the fill material was placed with a scraper and shaped with a bulldozer. The borrow areas included the hillsides at both the left and right abutments. Damage occurred to the principal spillway as described in Paragraph 1.2 G.

During the summer of 1980 the lake was drawn down and an attempt was made to locate the upstream end of the drawdown pipe. The downstream end of the pipe was capped and air was pumped into it to help locate the upstream end. The upstream end was then located and capped.

2.3 OPERATION:

The only operating equipment at the dam is the gate valve on the drawdown pipe. The drawdown pipe has been capped on both the upstream and downstream ends. Flood flows are passed by the principal spillway and the emergency spillway. No operating records of the dam are available. Failure of part of the dam occurred shortly after construction due to flow along the outside of the principal spillway pipe as described in Paragraph 1.2 G. The dam has never been overtopped and no evidence of overtopping was noted.

2.4 EVALUATION:

A. Availability:

Design information was available from the Scott County, Missouri Soil Conservation Service Office. Design surveys, a geologic investigation, embankment design, and hydrologic and hydraulic design information were available. No construction inspection was performed but a post-construction survey was performed. To our knowledge no inspections or surveys of the dam have occurred since that time.

B. Adequacy:

The engineering data obtained in combination with the field survey and visual inspection is considered adequate to support the conclusions in this report.

The design work done by personnel from the Scott County SCS office appeared to be accomplished with a minimum amount of detailed study. The records show no soil boring or soil analysis records. Also no construction inspection was provided. Therefore, the design data is felt to be inadequate to satisfy the requirement for a seepage and stability analysis as outlined in the recommended guidelines. The seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

A hydrologic design was also performed for the Lauck Lake watershed by SCS personnel. An independent hydrological and hydraulic analysis was done for this report and is presented in Section 5 and in Appendix B.

C. Validity:

The validity of the original embankment design is limited because of the lack of the knowledge of the properties of the soil used in the embankment. The original hydrologic study appears to be valid for the original condition of the watershed. Hydrologic properties of the watershed have changed somewhat and the hydrologic and hydraulic analysis presented in this report reflects those changes.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS:

A. General:

The field inspection was made on 3 December 1980. The inspection team consisted of personnel from Crawford, Murphy & Tilly, Inc. of Springfield, Illinois and from A & H Engineering Corporation of Carbondale, Illinois. The members were:

Nathan Wilcoxon, P.E. - Crawford, Murphy & Tilly, Inc.
Guy Freese, P.E. - A & H Engineering Corporation
Timothy Tappendorf, E.I.T. - Crawford, Murphy & Tilly, Inc.

The field inspection included the determination of dimensions and elevations of the dam and appurtenances necessary to show as a minimum a plan view, a dam crest profile, a spillway profile and section, and pertinent cross sections of the dam. For this report all elevations were obtained using the elevation of the centerline of Missouri Route A Highway at the centerline of a driveway located approximately 2,200 feet south and 2,500 feet west of the damsite as elevation 482.0 above Mean Seal Level. This information was obtained from information on the Chaffee, Missouri 7.5 minute quadrangle map. A visual inspection of the dam, spillways, drainage area, and downstream channel was performed and photographs were taken of each of them.

No one accompanied the inspection team during the inspection. Mr. Joe Bollinger and Mr. Dick Stiemle were interviewed the day of the inspection. Mr. William Schlosser of Schlosser Construction Company was contacted by telephone after the inspection.

Maps and general drawings of the dam and appurtenances are presented on Plates 1 through 5 in Appendix A and a hydrologic and hydraulic analysis is presented in Appendix C. Engineering design data obtained from the Scott County SCS are presented in Appendix D.

B. Regional and Project Geology:

The general southeastern Missouri area is underlain wholly or partially by Coastal Plain sediments. The Ozark Escarpment, which is the northwestern boundary, divides the lowland area from the Ozark Province. This is an irregular boundary which trends northeast by southwest from the southern sections of Cape Girardeau County through Bollinger County, Wayne County, Butler County and into Arkansas. All of Scott County, Stoddard County, Dunklin County, New Madrid County, Mississippi County and Pemiscot County (of the Mississippi embayment) are underlain by sediments of the Ozark Escarpment.

The Mississippi embayment is a broad arm of the Gulf Costal Plain which extends up the Mississippi River Valley from the Gulf of Mexico. The outer rim of this embayment is outlined by outcrops of consolidated Paleozoic sediments. The embayment is structurally a downwarped, spoon-shaped trough developed on the Paleozoic rocks.

One of the most prominent topographic features of the embayment is the Benton Hills of northern Scott County and southern Cape Girardeau County. The Benton Hills Ridge dominates the subsurface geology of Scott County. The dam site lies on the west central section of Benton Hills Ridge. A significant fault zone splits Scott County, just south of the Benton Hills region.

The subsurface geology around this site is comprised of Quaternary, Cretaceous and Ordovician deposits. The Ordovician bedrock overlies the Cambrian bedrock.

The immediate dam site is covered with a relatively thin layer of silt rich modified loess (ML-CL).

Underlying the modified loess soils and exposed on the sides of the valley where the dam is located, is a sandy clay with scattered gravel and thin sandstone beds. This sandy clay formation is believed to be the McNairy (Ripley) formation.

Rock outcrops were not observed in the immediate site area although there were a few large boulders of sandstone and cherty sandstone observed in the downstream channel. The bedrock underlying the dam site is the St. Peter sandstone of the Champlainian Series. The St. Peter formation is comprised of a well-sorted, massive medium to fine sized grain, rounded grain, quartozose sandstone, with some local orthoquartizite. The sandstone beds are occasionally cross bedded and exhibit ripplemarks. The thickness of this formation ranges from 10 to more than 100 feet. The St. Peter sandstone is a firm rock formation. The upper portions of this formation are usually weathered and some leakage can occur in the upper part of the formation.

The dam site is located in Seismic Zone 3 as shown on the Seismic Zone Map on Plate 3 of Appendix A. The site is located north of the New Madrid area which is seismically active at the present time.

C. Dam:

Lauck Lake Dam is an earthfill dam with a height of approximately 33.4 feet and a length at the crest of approximately 250 feet. There is a principal spillway consisting of a 6 inch diameter smooth steel pipe that slopes through the embankment. There is an emergency spillway channel cut into original ground just right of the right abutment. There is a drawdown facility consisting of a 4 inch diameter PVC Schedule 40 plastic pipe through the embankment with a gate valve controlled at a valve box near the toe of the dam. The overall condition of the dam appeared to be good.

Both vertical and horizontal alignment of the crest of the dam appear fairly uniform. The horizontal alignment of the crest is a straight line and the crest has a width of approximately 12 feet.

The elevation of the centerline of the crest of the dam varies from 468.3 to 470.1. Although there is 1.8 feet of variation in the crest elevation the visual inspection of the vertical alignment reveals no major problem. Most of the variations appeared to be caused by the upward slope of the embankment crest as it approaches the left abutment. The profile of the crest of the dam is shown on Exhibit 3 of Appendix B.

The upstream and downstream slopes of the dam are fairly uniform and the crest of the dam is slightly rounded. A typical cross section of the dam can be seen on Plate 5 of Appendix A.

The embankment had a cover of grass with some weeds noted. There were several sparse areas noted, especially on the crest, where automobiles had apparently driven across the dam. No trees were noted on the embankment. The upstream slope, the crest, and the downstream slope of the dam can be seen in Photographs 2, 3 and 4 respectively. No sloughing was noted but there was minor erosion on the downstream slope with the deepest erosion toward the bottom of the slope near the principal spillway outlet. A view of a typical erosion gully can be seen in Photograph 10. There were several animal burrows noted on the downstream face of the dam and a view of one of them is shown in Photograph 11. There is no riprap on the upstream face of the dam, but no shoreline erosion due to wave action was noted. No erosion protection on the upstream face of the dam appeared to be necessary at the time of the inspection.

No surface cracks or unusual movement or cracking at or beyond the toe of the dam was noted. There was no seepage noted and no foundation drains were observed.

A shallow soil sample was obtained from the embankment near the center of the crest. The sample was classified as a brown clayey silt (ML). The potential for erosion is high for this soil type.

D. Appurtenant Structures:

D.1 Principal Spillway:

The principal spillway consists of a 6 inch diameter smooth steel pipe which slopes through the embankment and is located 75 feet right of the left abutment. The pipe is approximately 133 feet in length and has a slope of approximately 25%.

That portion of the principal spillway pipe that could be observed appeared to be in good condition but slightly rusted. The intake end of the pipe and the trash rack covering it can be seen in Photograph 5. The principal spillway has a canopy inlet and a basket type trash rack. The dimensions of the inlet and trash rack are given on Sheet 7 of Appendix D. The concrete surrounding the inlet was poured in the spring of 1980 to help prevent erosion around the inlet. The concrete was dumped and not finished and has a rough surface.

According to the original design there are three steel plate anti-seep collars which are 4 feet by 4 feet and located as shown on Sheet 2 of Appendix D. The downstream end of the principal spillway can be seen in Photograph 6. The downstream end of the pipe was covered with about 6 inches of silt on the day of the inspection. According to Elks Lodge members this was due to silt which had come from the drawdown facility when the lake was drawn down in the summer of 1980. On the day of the inspection the lake level had not risen back to the principal spillway crest since being drawn down. It is believed that the silt covering the outlet of the principal spillway will be washed away by the next flow from the spillway.

D.2 Emergency Spillway:

The emergency spillway is an excavated trapezoidal channel just to the right of the right abutment. A view of the emergency spillway channel can be seen in Photographs 7 and 8. The emergency spillway flow line profile is shown on Exhibit 4 and the emergency spillway cross section at the control section is shown on Exhibit 5 of Appendix B. The bottom and the right side slope of the emergency spillway channel appeared to be original undisturbed earth of the hillside at the right abutment. The berm which forms the left slope of the channel appeared to be fill material that is approximately 2 to 4 feet in depth.

The approach channel has a length of about 20 feet at a slope of about -3.5%. Since the lake level was 7 feet below normal pool level on the day of the inspection, another 25 feet of the slope was exposed that would be submerged at normal pool. This area was covered with brush and weeds. The crest has a length of about 50 feet at a slope of 0.4%. At the control section the channel has a bottom width of 10 feet and has a right side slope of 8 horizontal to 1 vertical and a left side slope of 5.5 horizontal to 1 vertical.

The crest has a grass cover with several bare spots. The discharge channel has a length of 20 feet at a slope of 3.1%. The flow then exits onto the hillside of a draw which joins the downstream channel beyond the toe of the dam. The emergency spillway channel is free of any obstructions which seriously reduce its capacity.

D.3 Drawdown Facility:

The drawdown facility consists of a 4 inch diameter PVC Schedule 40 plastic pipe which extends through the embankment and is located approximately 115 feet right of the left abutment. The exact length of the pipe and the location of the upstream end is not known. The downstream end of the pipe extends 10 feet beyond the toe of the dam. A valve box which covers a gate valve is located at the toe of the dam. The downstream end of the drawdown pipe and the valve box can be seen in Photograph 9.

According to information obtained from Mr. Richard Stiemle the drawdown facility was modified during the summer of 1980. The lake was first drawn down and then 6 feet of extension pipe was added to the downstream end. This extension pipe was capped and the cap had a valve through which air could be pumped. Air was pumped into the pipe and the upstream end located from the bubbles which formed in the lake and the upstream end was capped. Mr. Stiemle said that this was done to keep the drawdown pipe from filling with silt.

E. Reservoir and Watershed:

The watershed for Lauck Lake Dam contains approximately 35 acres. The surface area of the lake is about 12% of the watershed area when it is at the principal spillway crest elevation of 464.0 and about 15% when it is at the top of the dam elevation of 468.3. A view of the lake and the forest surrounding it is given on Photograph 12. About 50% of the watershed area is forest similar to that surrounding the lake and has average slopes of 12 to 15%. The remaining 50% of the watershed area consists of recreational areas developed by the Elks Lodge and pasture land. The recreational areas include a softball field and a picnic area. Some grading of these areas apparently was done and some of the ground cover is sparse. Slopes of these areas range from flat to 10%. A view of the watershed near the upstream boundary is shown on Photograph 13.

All of the surface soil in the watershed belongs to the Memphis Series which is in hydrologic Group B as defined by the SCS. Since the lake is only three years old sedimentation is believed to be minor. The potential for sedimentation appeared to be high since much of the recreational area has been graded and has a sparse surface cover in many places. The lake water appeared murky the day of the inspection. Erosion from the forested areas appeared to be minimal.

F. Downstream Channel:

The downstream channel is a V-shaped channel which is several feet deep. The channel has a slope of about 3% and is lined with thick brush and trees on steep hillsides for approximately 1,000 feet. A view from the dam of the downstream channel can be seen in Photograph 14. The valley then widens and the valley floor consists of pasture land. The stream flows approximately 3,000 feet at an average slope of 1% before its confluence with Hindman Creek. A view of the channel and a dwelling located beside it is given on Photograph 15.

3.2 EVALUATION:

The overall condition of this dam is good. Several deficiencies exist which need to be corrected. The lack of a seepage and stability analysis, including seismic loading, is a deficiency which should be corrected. The erosion gullies on the downstream face of the dam should be filled and reseeded. Any animals that begin burrowing in the embankment should be removed and their burrows fill and disturbed areas seeded. The vegetal cover on the dam and in the emergency spillway channel is sparse in many areas. The bare areas should be seeded to grass and the dam should be mowed regularly to control the growth of weeds and to promote a thick grass cover which will help control erosion. A better vegetal cover should also be promoted on the recreational areas or other means provided to control erosion and siltation of the reservoir.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES:

The only operating equipment at Lauck Lake Dam is the gate valve on the drawdown facility. Flows from the lake are passed by the principal spillway pipe and through the emergency spillway channel. The gate valve on the drawdown pipe is operable but both the upstream and downstream ends of the pipe are capped and the caps must be removed before the drawdown pipe will operate. No regular schedule of operation is known to exist.

4.2 MAINTENANCE OF THE DAM:

Maintenance of the dam is performed as directed by the Elks Lodge. According to Mr. Dick Stiemle someone is hired to mow the grass periodically and to provide other maintenance as required. No regular maintenance schedule exists. It appeared that no maintenance of the dam had been performed recently.

4.3 MAINTENANCE OF OPERATING FACILITIES:

The only operating equipment at the lake is the gate valve on the drawdown pipe. The pipe was capped on both ends to prevent it from clogging with silt. No other maintenance is done to the drawdown facility.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT:

No warning system is known to exist.

4.5 EVALUATION:

Maintenance of the dam needs to be improved and should be performed on a regular basis. All erosion gullies should be filled and seeded. Any animals that begin burrowing in the embankment should be removed and their burrows filled and disturbed areas seeded. The dam should be mowed regularly to control weeds and prevent any trees from growing on the dam and to promote a thick grass cover. Any debris which collects around the principal spillway inlet should be removed. The gate valve on the drawdown pipe should be opened and closed periodically to keep it operable. A record of maintenance performed should be kept.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES:

A. Design Data:

Hydrologic and hydraulic design for Lauck Lake Dam was done by Scott County SCS personnel and their computations are presented in Appendix D. An independent hydrologic and hydraulic analysis was done for this report.

The significant dimensions of the dam and reservoir were measured or surveyed on the date of inspection or estimated from available topographic mapping. The map used in the analysis is the 7.5 minute U.S. Geological Survey quadrangle sheet for Chaffee, Missouri, dated 1963 and photo revised 1978. Surface soil information was available from a map obtained from the Scott County Soil Conservation Service Office.

B. Experience Data:

No recorded rainfall, runoff, discharge, or lake stage data were available for the lake and watershed. Information obtained from Mr. Dick Stiemle indicated that there was a 6 inch rainfall soon after construction of the dam that "washed out" the principal spillway as described in Paragraph 1.2 H. The dam has never been overtopped.

C. Visual Observations:

Descriptions of the watershed and reservoir, principal spillway, emergency spillway, and drawdown facility are given in Section 3. The lake level is controlled by the principal spillway and the emergency spillway. Concrete was poured around the principal spillway inlet in the spring of 1980 and an apparent high water mark was noted on this concrete at elevation 465.1. No other high water marks were noted. According to Mr. Dick Stiemle the dam has never been overtopped and no evidence of overtopping was seen. The crest of the principal spillway is 1.8 feet below the emergency spillway crest and 4.3 feet below the top of the dam.

A description of the downstream channel is given in Paragraph 3.1 F. The downstream hazard zone extends approximately 2 miles downstream from the dam and includes 5 or more dwellings and several farm buildings.

D. Overtopping Potential:

Based on the hydrologic and hydraulic analysis presented in Appendix B, the dam and its spillway have the capacity to store and pass approximately 50 percent of the Probable Maximum Flood (PMF) with only very minor overtopping. The Probable Maximum Flood is defined as the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in a region. The recommended

guidelines from the Department of the Army, Office of the Chief of Engineers, require that this dam which is in the small size category with a high downstream hazard potential classification pass 50 to 100 percent of the PMF without overtopping. The dam has a relatively small storage capacity of 62 acre-feet and a small drainage area of 35 acres. The downstream flood plain becomes relatively wide approximately 0.2 miles downstream from the dam and the nearest dwelling in the hazard zone is approximately 0.5 miles downstream from the dam. Considering these facts, 50 percent of the PMF has been determined to be the appropriate spillway design flood. Although a minor amount of overtopping will occur during the 50 percent PMF event, (approximately 1 inch maximum depth of overtopping for 15 minutes as determined by the HEC-1 Computer Program) it appears that this minor overtopping is unlikely to cause dam failure since the dam is in good condition. The dam approximately passes the recommended spillway design flood, therefore, the spillway capacity of this dam is considered adequate. The dam and spillway will hold and pass a 1 percent probability flood without overtopping the dam.

Data for the 45 percent PMF, 50 percent PMF, and the 100 percent PMF is presented in the table below.

Percent PMF	Starting Pool Elevation (MSL)	Peak Inflow To Lake (cfs)	Maximum Pool Elevation (MSL)	Maximum Depth Over Dam (feet)	Peak Discharge (cfs)	Overtopping Duration (hours)
45%	464.3	491	468.22	0	199	0
50%	464.3	546	468.37	0.07	233	0.25
100%	464.3	1092	469.15	0.85	823	0.67

The starting pool elevations were found by assuming the lake level was at the crest of the principal spillway at elevation 464.0 and then applying an appropriate antecedent storm four days prior to the storm being analyzed. The antecedent storm for the analysis of the PMF ratio storms is a storm half the magnitude of the storm being analyzed, as recommended in the "Hydrologic/Hydraulic Standards" prepared by the Corps of Engineers, St. Louis District. The antecedent storm for the analysis of the 45 percent PMF was 22 percent of the PMF. The antecedent storm raised the lake level to 467.0 and in four days outflow from the emergency spillway and the principal spillway had reduced the lake elevation to 464.3. The lake level also returned to approximately the same elevation of 464.3 following the antecedent storms for the 50% PMF and 100% PMF. No reduction in flow due to collection of debris around the pipe inlet was assumed. The trash rack is believed to be adequate to prevent clogging especially when the inlet is submerged.

The capacity of the principal spillway when the lake level is at the top of the dam is 2.2 cfs and the capacity of the emergency spillway is 212 cfs.

Overtopping of an earthen embankment could cause serious erosion and lead to failure of the structure. Flood discharges resulting from a failure of Lauck Lake Dam could be expected to produce substantial stage rises in the hazard zone. Overtopping would lead to potential loss of life.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY:

A. Visual Observations:

Observed features which could adversely affect the structural stability of this dam, are discussed in Section 3 of this inspection report.

B. Design and Construction Data:

An engineering geologic report for Lauck Lake was prepared by the Missouri Department of Natural Resources. The conclusion of the report is that the surface appearance of the proposed site indicates that it is geologically suitable for a lake.

Design of the dam was done by the Scott County Soil Conservation Service and the dam was constructed by the Schlosser Construction Company as discussed in Section 2 of this report. It is felt that the design does not satisfy the seepage and stability analyses requirements of the inspection guidelines. This situation constitutes a deficiency which should be corrected.

C. Operating Records:

No operating records have been kept for the dam.

D. Post-Construction Changes:

According to Elks Lodge members Richard Stiemle and Joe Bollinger, there was a rainfall of about 6 inches which filled the lake soon after construction and caused the principal spillway pipe to wash out. The pipe was repaired by the contractor at that time.

The dam was constructed by Schlosser Construction Company. According to Mr. William Schlosser, there was a cold spell during construction and that the soil around the principal spillway pipe did not settle very well due to the cold weather. Shortly thereafter a rain caused the lake to fill and flow along the outside of the principal spillway pipe eroded the soil around the pipe and the embankment above the pipe collapsed. Mr. Schlosser said he then installed a new pipe, which also had three anti-seep collars, and wetted the fill material around the pipe as it was placed to achieve better compaction around the pipe.

In the spring of 1980 concrete was poured around the inlet end of the principal spillway. In the summer of 1980 a short piece of PVC pipe was added to the downstream end of the drawdown pipe and both the upstream and downstream ends of the pipe were capped.

None of these changes significantly affected the structural stability of the dam.

E. Seismic Stability:

This dam is located in Seismic Zone 3 as shown on the Seismic Zone Map on Plate 3 of Appendix A. Zone 3 delineates areas in which major damage would result from the expected seismic activity in this area. An accurate slope stability analysis with seismic loading cannot be made because of the lack of original design data and soil strength parameters. It should be noted that due to the relatively steep embankment slopes and the apparent embankment soil type, in the event of potential seismic loading, the slopes may become unstable and suffer major damage.

SECTION 7 - ASSESSMENT/REMEDIAL PROCEDURES

7.1 DAM ASSESSMENT:

A. Safety:

Several items were noted during the field inspection that could adversely affect the safety of the dam. These items are: (1) poor vegetal cover at many locations on the dam; (2) minor erosion problems on the downstream face of the dam; and, (3) burrowing animals present on the dam.

Another deficiency was the lack of seepage and stability analyses. This deficiency should be corrected, especially since the dam is located in Seismic Zone 3.

B. Adequacy of Information:

The conclusions in this report were based on the performance history as related by others, visual observation of external conditions, data from available mapping, and design surveys and computations done by SCS personnel. The inspection team considers that these data are sufficient to support the conclusions herein. Seepage and stability analyses comparable to the Recommended Guidelines for Safety Inspection of Dams were not available, which is considered a deficiency.

C. Urgency:

The remedial measures recommended in Paragraph 7.2 should be accomplished in the near future. If good maintenance is not provided, the embankment condition could deteriorate and possibly could become serious in the future.

D. Necessity for Additional Inspection:

Based on the results of Phase I inspection, additional periodic inspections are recommended.

7.2 REMEDIAL MEASURES:

The following remedial measures and maintenance procedures are recommended. All remedial measures should be performed under the guidance of a professional engineer experienced in the design and construction of dams.

A. Recommendations:

1. A seepage and stability analyses comparable to the requirements of the recommended guidelines should be performed by an engineer experienced in the design and construction of dams. Since the dam is located in Seismic Zone 3, the analyses should include seismic loading.

B. Operation and Maintenance Procedures:

1. All erosion gullies should be filled and reseeded.

2. All burrowing animals should be removed and their burrows filled and disturbed areas seeded.

3. The grass cover on the dam and the emergency spillway channel needs to be improved by reseeding and regular mowing.

4. Any debris which collects around the principal spillway inlet should be promptly removed.

5. The gate valve on the drawdown pipe should be opened periodically to keep it operable.

6. The principal spillway pipe should be monitored for any problems such as erosion at the upstream end or flow along the outside of the pipe which might cause damage similar to that which occurred just after construction of the dam.

7. The dam should be periodically inspected by an experienced engineer and records kept of these inspections and maintenance efforts.

PHASE I INSPECTION REPORT

APPENDIX A

MAPS AND GENERAL DRAWINGS

APPENDIX A

MAPS AND GENERAL DRAWINGS

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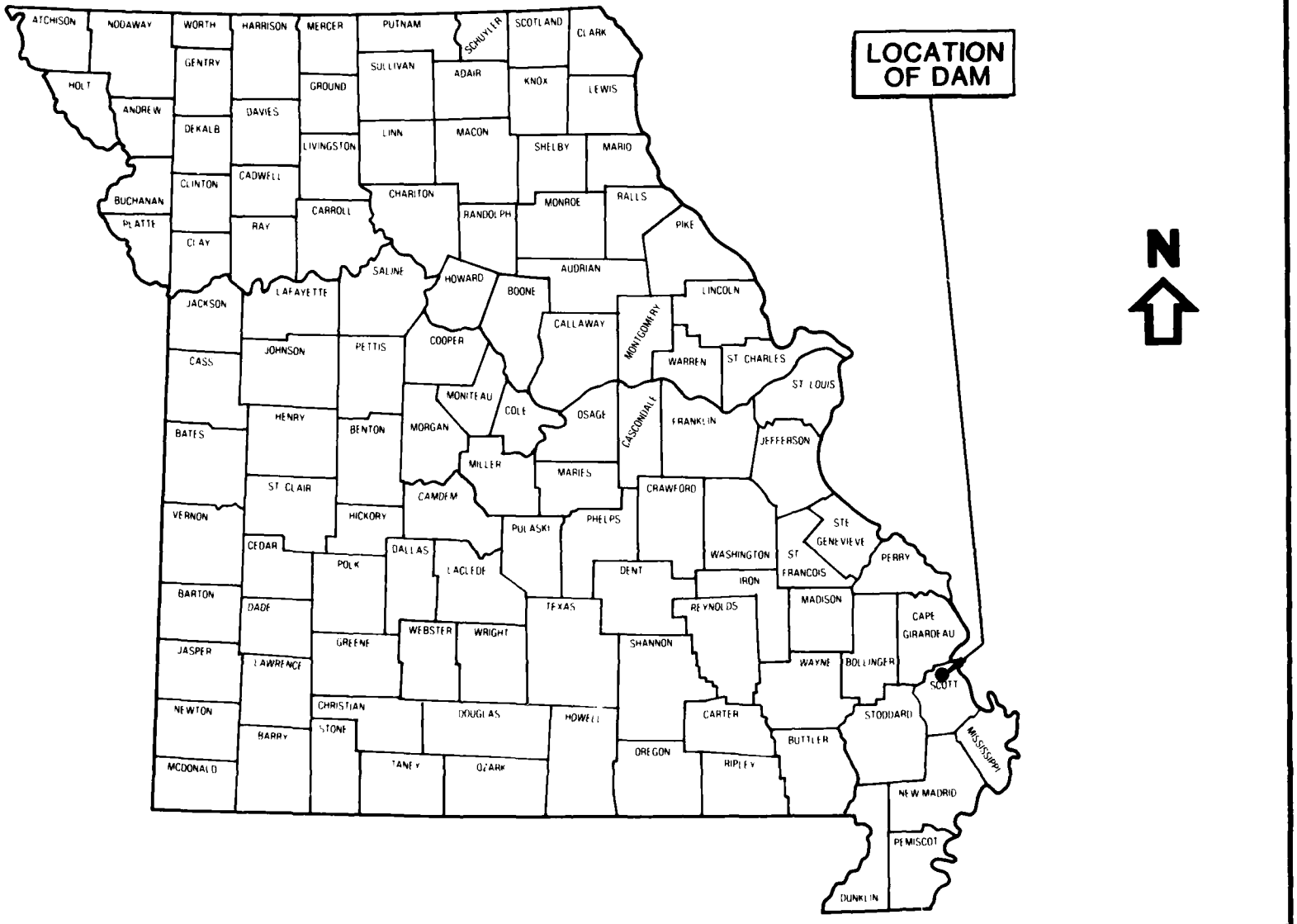

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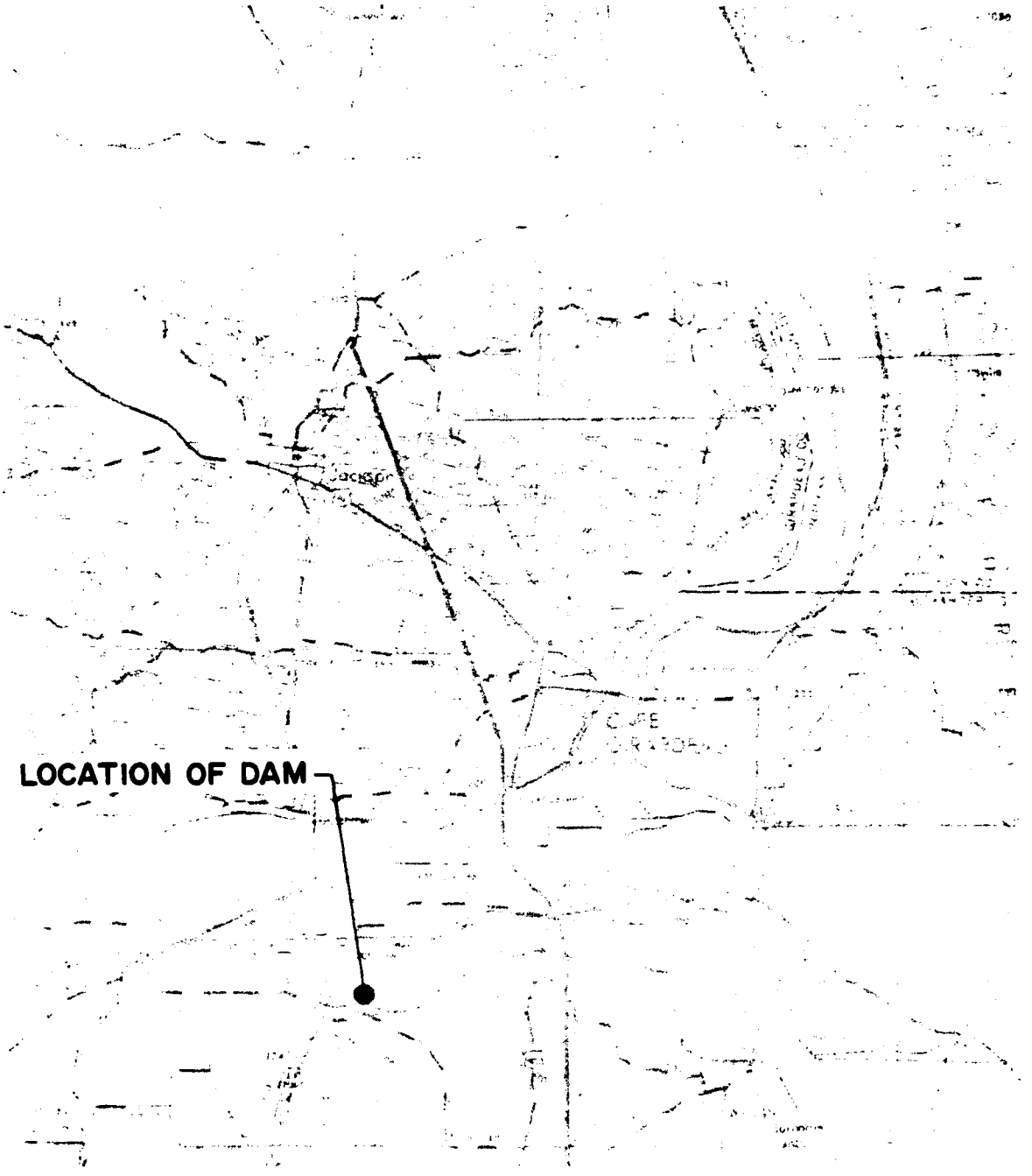
NATIONAL DAM SAFETY PROGRAM

LOCATION MAP

LAUCK LAKE DAM MO40068

PLATE 1



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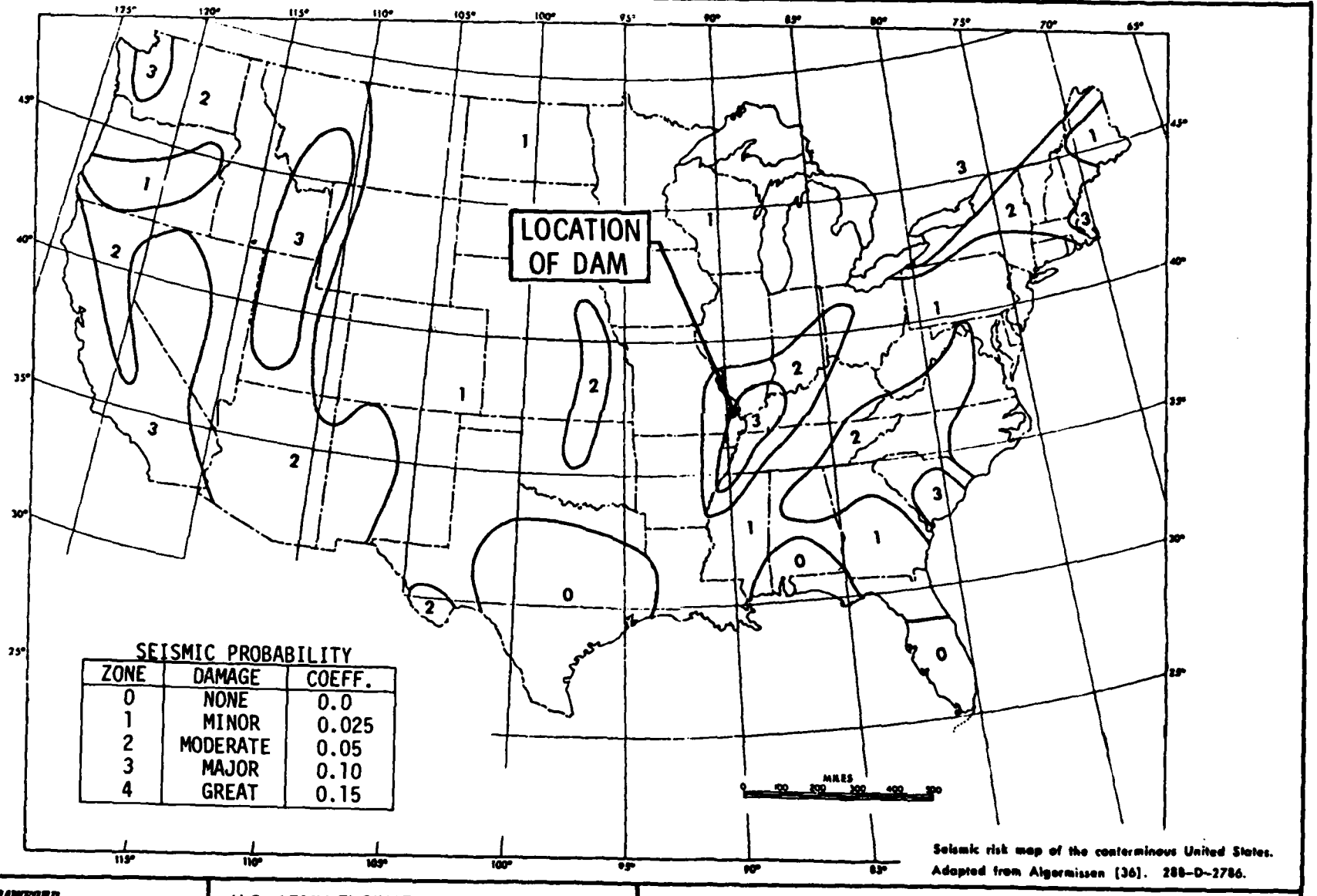
VICINITY MAP
LAUCK LAKE DAM MO40068

PLATE 2



SEISMIC PROBABILITY

ZONE	DAMAGE	COEFF.
0	NONE	0.0
1	MINOR	0.025
2	MODERATE	0.05
3	MAJOR	0.10
4	GREAT	0.15

Seismic risk map of the conterminous United States. Adapted from Algermissen [36]. 288-D-2786.

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SEISMIC ZONE MAP OF CONTIGUOUS STATES
LAUCK LAKE DAM

PLATE 3

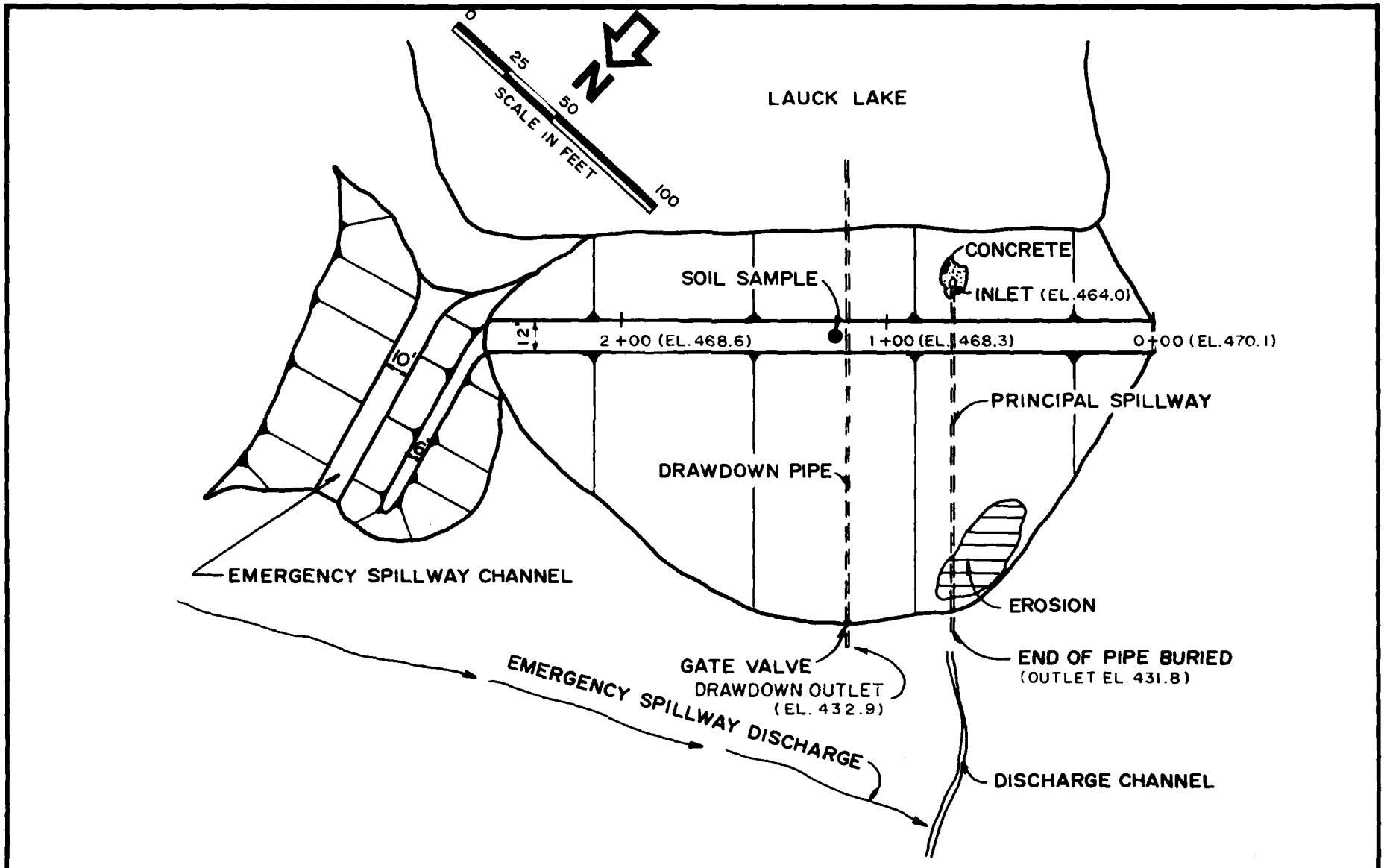

PLATE 4

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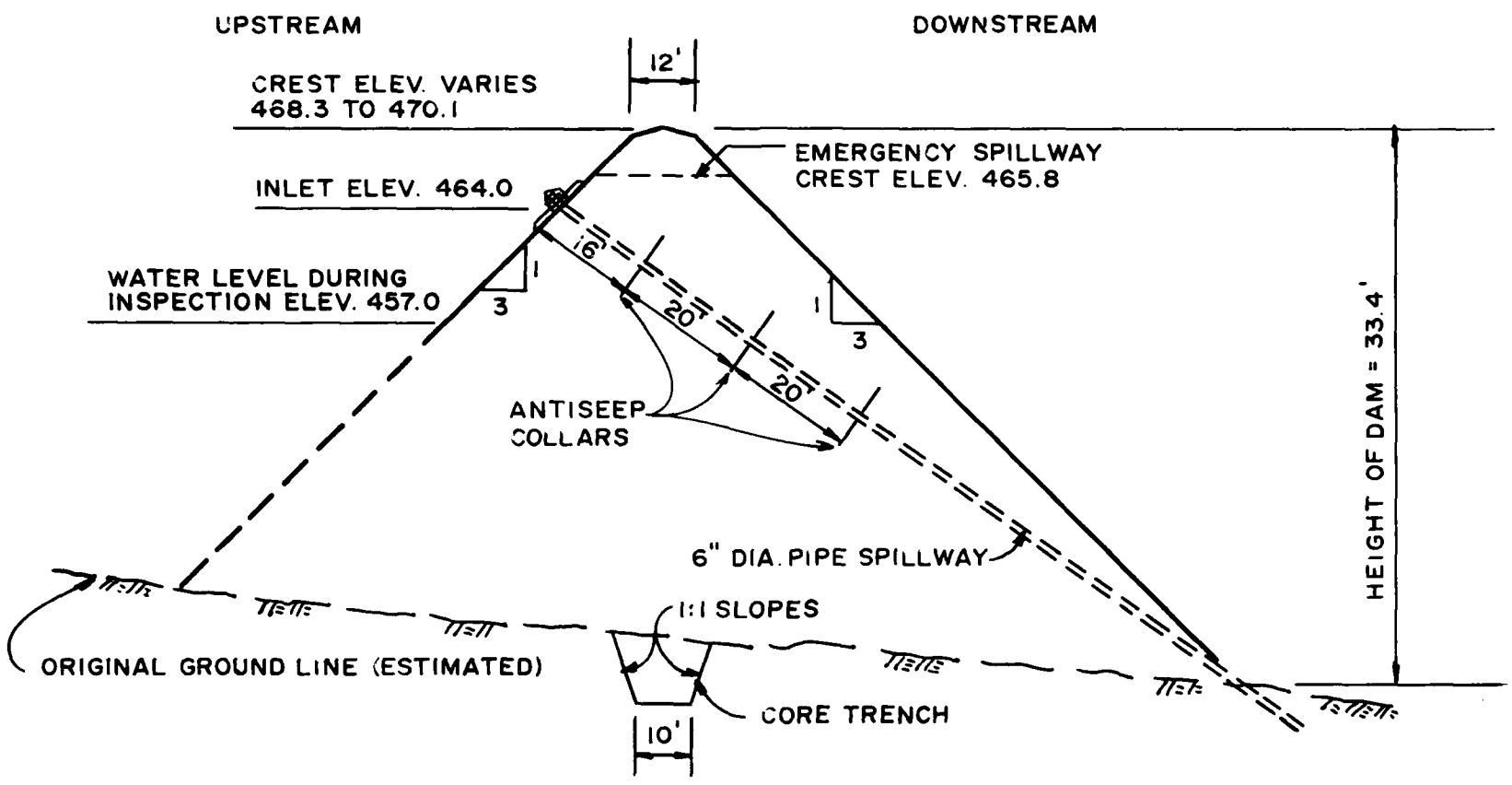
PLAN OF DAM AND SPILLWAY
LAUCK LAKE DAM M040068



TYPICAL CROSS SECTION OF DAM

APPROXIMATE SCALE
HORIZ. 1" = 30'
VERT. 1" = 10'

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PLATE 5

PHASE I INSPECTION REPORT

APPENDIX B

HYDROLOGIC AND HYDRAULIC ANALYSIS

APPENDIX B

HYDROLOGIC AND HYDRAULIC ANALYSIS

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EXHIBITS

APPENDIX B

HYDROLOGIC AND HYDRAULIC ANALYSIS

A. PURPOSE:

The purpose of this Appendix is to present the methodology used and the results of the hydrologic and hydraulic analysis. The analysis was done according to criteria presented in the Recommended Guidelines for Safety Inspection of Dams and in the St. Louis District Hydrologic/ Hydraulic Standards for Phase I Safety Inspection of Non-Federal Dams dated 22 August, 1980. The purpose of the analysis is to determine the overtopping potential for Lauck Lake Dam.

B. HYDROLOGIC AND HYDRAULIC ANALYSIS:

The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for a reservoir routing. Data for determination of the unit hydrograph was obtained from the U.S. Geological Survey 7.5 minute quadrangle map for Chaffee, Missouri dated 1963 and photo revised in 1978 and from the field inspection. A lake and watershed map is shown on Exhibit 1. The parameters used in the development of the unit hydrograph are presented in Table 1.

TABLE 1

UNIT HYDROGRAPH PARAMETERS

Drainage Area (A)	0.055 sq. miles
Length of Watercourse (L)	0.15 miles
Difference in Elevation (H)	86 feet
Time of Concentration (Tc)	0.05 hours
Lag Time (Lg)	0.03 hours
Time to Peak (Tp)	0.07 hours
Peak Discharge (Qp)	380 cfs
Duration (D) (smallest HEC-1 allows)	0.083 hours (5 minutes)

HEC-1 Unit Hydrograph

Time (Min.)	Discharge (cfs)
0	0
5	316
10	89
15	17
20	3
25	0

Formula Used:

$$Tc = \left[\frac{11.9\ L^3}{H}\right] 0.385$$

From "Design of Small Dams", 1973 (T_c verified by using overland flow time plus channel flow time method)

$$Lg = 0.6\ Tc$$

$$Tp = \frac{D}{2} + Lg$$

$$Qp = \frac{484\ A.Q}{Tp}$$

Q = Excess Runoff = 1 inch

The hypothetical storm that is applied to the unit hydrograph is the Probable Maximum Precipitation (PMP). It is derived and determined from regional charts prepared by the National Weather Service in "Hydrometeorological Report No. 33." No reduction factors have been applied to the PMP. A 24 hour storm duration is assumed with total depth distributed over 6 hour periods in accordance with procedures outlined in EM 1110-2-1411 (SPF determination). The maximum 6 hour rainfall period is then distributed to hourly increments by the same criteria. Within-the-hour distribution is based upon NOAA Technical Memorandum NWS HYDRO-35. The non-peak 6 hour rainfall periods are distributed uniformly. All distributed values are arranged in a critical sequence by the SPF. The final inflow hydrograph is produced by deduction of infiltration losses appropriate to the soil, land use, and antecedent moisture conditions. Soil Conservation Service and land use and slopes were determined from the field inspection and available mapping and are presented in Section 3. Antecedent Moisture Condition III (AMC III) was used for the analysis of the PMP percentage storms.

A 1 percent probability storm was also analyzed. The rainfall amount and distribution for the 1 percent probability storm with a 24 hour duration for a drainage area of 0.5 square miles for the Cape Girardeau, Missouri, area was obtained from the St. Louis District, Corps of Engineers and used for the analysis. Antecedent Moisture Condition III (AMC III) was used for the analyses of the 1 percent probability storm. The rainfall applied, the parameters used to determine infiltration losses and the resulting runoff are presented in Table 2.

TABLE 2

RAINFALL-RUNOFF PARAMETERS

Selected Storm Event	Storm Duration (hours)	Rainfall (inches)	Runoff (inches)	Losses (inches)
PMP	24	35.10	33.08	2.02
1% Probability Storm	24	7.08	5.45	1.63

Additional Data:

1. Soil Conservation Service Runoff Curve Number CN = 83 (AMC III).
2. Percentage of Drainage Basin Impervious = 14 percent.

The reservoir routing is accomplished by using the Modified Puls routing technique in which the flood hydrograph is routed through lake storage. The hydraulic capacity of the spillway and the crest of the dam are used as outlet controls in the routing. Storage in the pool area is defined in an elevation-storage capacity curve. The hydraulic capacity of the spillway and top of the dam are defined by elevation-discharge curves.

The elevation-storage capacity curve was developed by determining the lake surface area at various elevations using available mapping and then inputting this information to the HEC-1 computer program. The computer program then developed an elevation-storage capacity curve using the conic method. An Elevation-Area-Capacity curve is shown on Exhibit 2.

For the overtopping analysis the top of the dam is the lower of the following elevations: (1) The minimum elevation of embankment as determined by simple field surveys. (2) The lake elevation at which corresponding outflow velocities, as determined from simple hydraulic formula, exceed the suggested maximum permissible mean channel velocities. The top of the dam was determined to be 468.3 which is the minimum elevation of the embankment. Outflow velocities in the emergency spillway when the lake is at this elevation are at or below the suggested maximum permissible mean channel velocities for grass-lined channels with silt clay soil. Therefore only minor erosion of the emergency spillway channel is expected by flows when the lake level is at or below the top of the dam.

The elevation-discharge capacity curve for the top of the dam was developed using the non-level crest option of the HEC-1 computer program. The program assumes critical flow over a broad-crested weir and uses the formula $Q=CLH^{1.5}$. The coefficient C was chosen to be 2.6 as found in Handbook of Hydraulics, 5th Edition, by Horace William King and Ernest F. Brater. A profile of the dam crest is given on Exhibit 3.

The hydraulic capacity of the principal spillway was determined using the formula $Q=CA\ (2gh)^{0.5}$ for orifice control with a coefficient C of 0.7 as found in Handbook of Hydraulics, 5th Edition, by Horace William King and Ernest F. Brater. The dimensions of the inlet end of the spillway and the trash rack which surrounds it are shown on Sheets 6 and 7 of Appendix D. The flow through the trash rack was assumed to be adequate so that the capacity of the principal spillway was not reduced. Even if the pipe inlet became clogged, the effect on the determination of the overtopping percentage would be minor.

The hydraulic capacity of the emergency spillway was determined using methods found in the U.S. Department of Agriculture Soil Conservation Service Technical Release No. 2, Earth Spillways, dated October 1, 1956. The profile of the emergency spillway flow line and a cross section of the channel as surveyed in the field were used in this determination and they are shown on Exhibits 4 and 5. The elevation-capacity data for both the principal spillway and the emergency spillway that was input to the computer is shown in Table 3.

TABLE 3

LAKE ELEVATION VS. SPILLWAY CAPACITY

*Lake Elevation (MSL)	Principal Spillway Capacity (cfs)	Emergency Spillway Capacity (cfs)	*Total Spillway Capacity (cfs)
464.0	0	0	0
464.5	0.7	0	0.7
465.0	1.0	0	1.0
465.8	1.4	0	1.4
466.3	1.6	4.5	6
466.8	1.8	20	22
467.3	1.9	60	62
467.8	2.1	120	122
468.3	2.2	212	214
468.8	2.4	340	342
469.3	2.5	515	518
469.8	2.6	705	708

(*Values Input to the HEC-1 Computer Program)

The dam overtopping analysis has been conducted by hydrologic methods for this dam and lake. This analysis determines the percentage of the PMF hydrograph that the reservoir can contain without the dam being effectively overtopped. According to Hydrologic/Hydraulic Standards developed by the Corps of Engineers, St. Louis District, an antecedent storm should be applied to the watershed before analysis of the PMF. The antecedent storm precedes the storm being analyzed by 4 days. The starting elevation at the beginning of the antecedent storm was assumed to be at the elevation of the principal spillway crest. The antecedent storm for the analysis of the PMF ratio storms is a storm half the magnitude of the storm being analyzed. The antecedent storm used for the analysis of the 45% PMF was 22% of the PMF which caused the lake level to rise to an elevation of 467.0 and after 4 days outflow from the principal spillway and the emergency spillway had reduced the lake elevation to 464.3. This elevation was also used as the starting elevation for the analysis of the 50% PMF and 100% PMF, because the lake level returned to approximately the same elevation following the antecedent storms for these ratios of the PMF.

The antecedent storm for the analysis of the 1% probability storm is the rainfall in the 24 hours preceding the peak 24-hour period assuming a 48-hour duration. The computer program is only able to model a 24-hour storm when the time interval is 5 minutes, as it was for this analysis. Therefore, for the analysis of Lauck Lake Dam, the antecedent rainfall was assumed to infiltrate and result in the AMC III used for the analysis of the peak 24-hours. The starting elevation of the lake was assumed to be 464.0.

The above methodology has been accomplished for this report using the systemized computer program HEC-1 (Dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, Californis. The numeric parameters estimated for this site and input to the program are listed on Exhibit 6. Definitions of these variables are contained in the "User's Manual" for the computer program.

The computer printout of the inflow to the lake and outflow from the lake for the 45% PMF, 50% PMF and 100% PMF are presented on Exhibits 7, 8 and 9 respectively. The computer printout summary table for the overtopping analysis is presented on Exhibit 10.

C. REFERENCES:

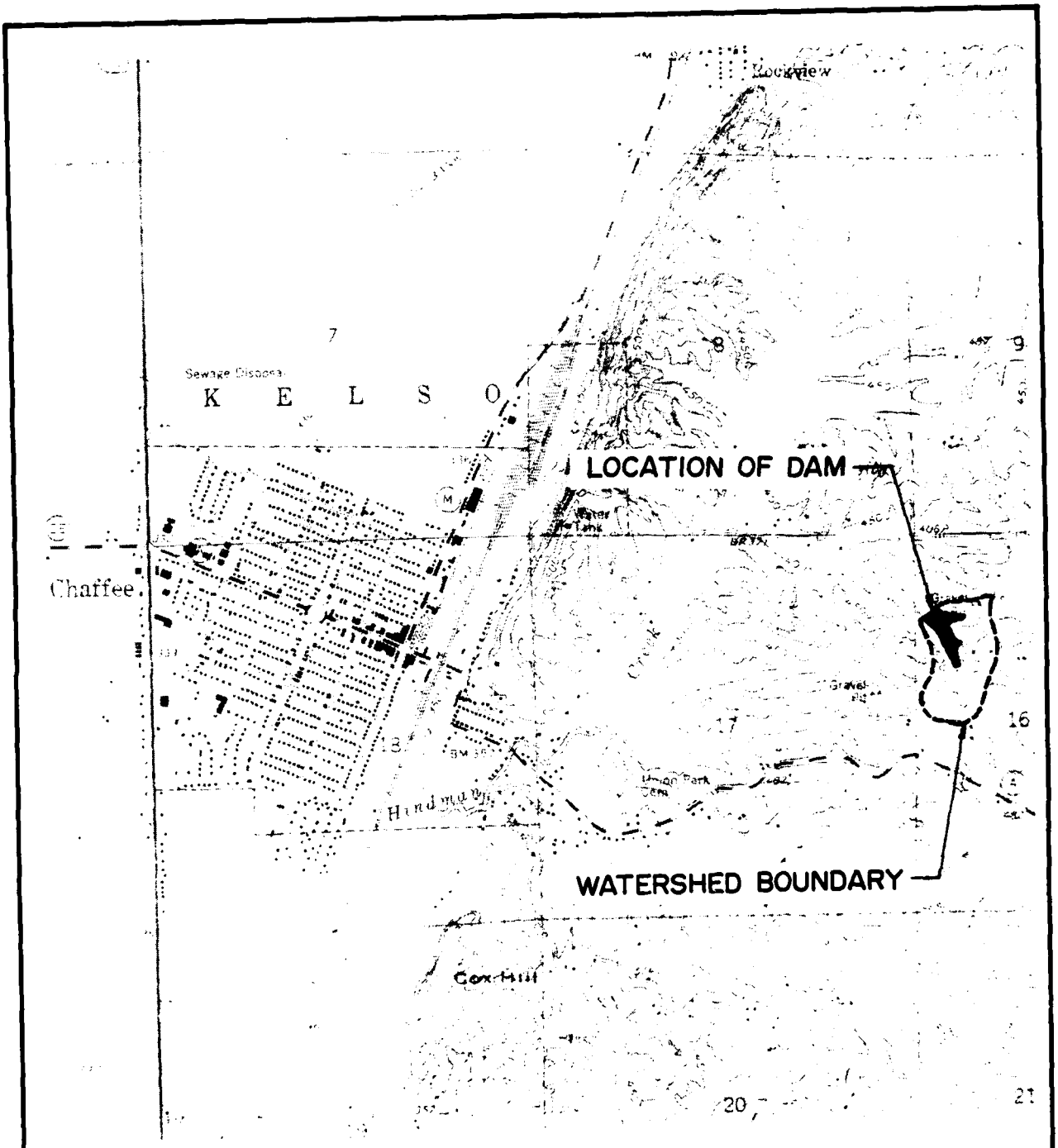
a. Design of Small Dams, United States Department of the Interior, Bureau of Reclamation, Second Edition, 1973.

b. Earth Spillways, Technical Release No. 2, Soil Conservation Service, United States Department of Agriculture, Engineering Division, October, 1956.

c. Flood Hydrograph Package (HEC-1), Users Manual for Dam Safety Investigations, The Hydrologic Engineering Center, U. S. Army Corps of Engineers, Davis, California; September, 1978.

d. King, Horace Williams, and Brater, Ernest F., Handbook of Hydraulics, Fifth Edition, 1963.

e. Riedel, J. T., Appleby, J. F., and Schloemer, R. W., Seasonal Variation of the Probable Maximum Precipitation East of the 105th Meridian for Areas from 10 to 1000 Square Miles and Durations of 6, 12, 24 and 48 Hours, Hydrometeorological Report No. 33, U.S. Department of Commerce, Weather Bureau, April 1956.

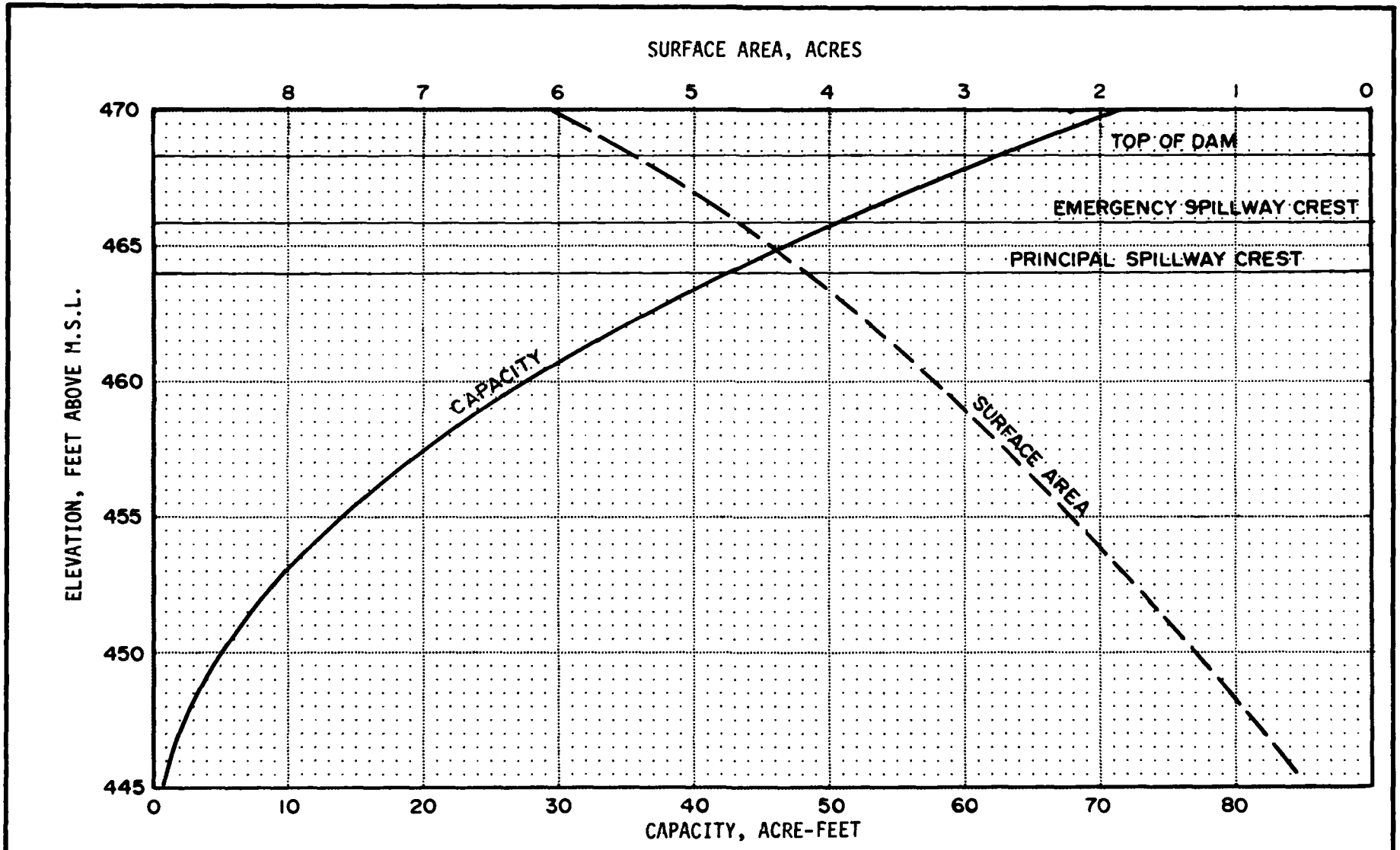


N

SCALE
1" = 2000'

CM&T	U.S. ARMY ENGINEER DISTRICT, ST. LOUIS CORPS OF ENGINEERS NATIONAL DAM SAFETY PROGRAM	LAKE AND WATERSHED MAP LAUCK LAKE DAM M040068

EXHIBIT 1



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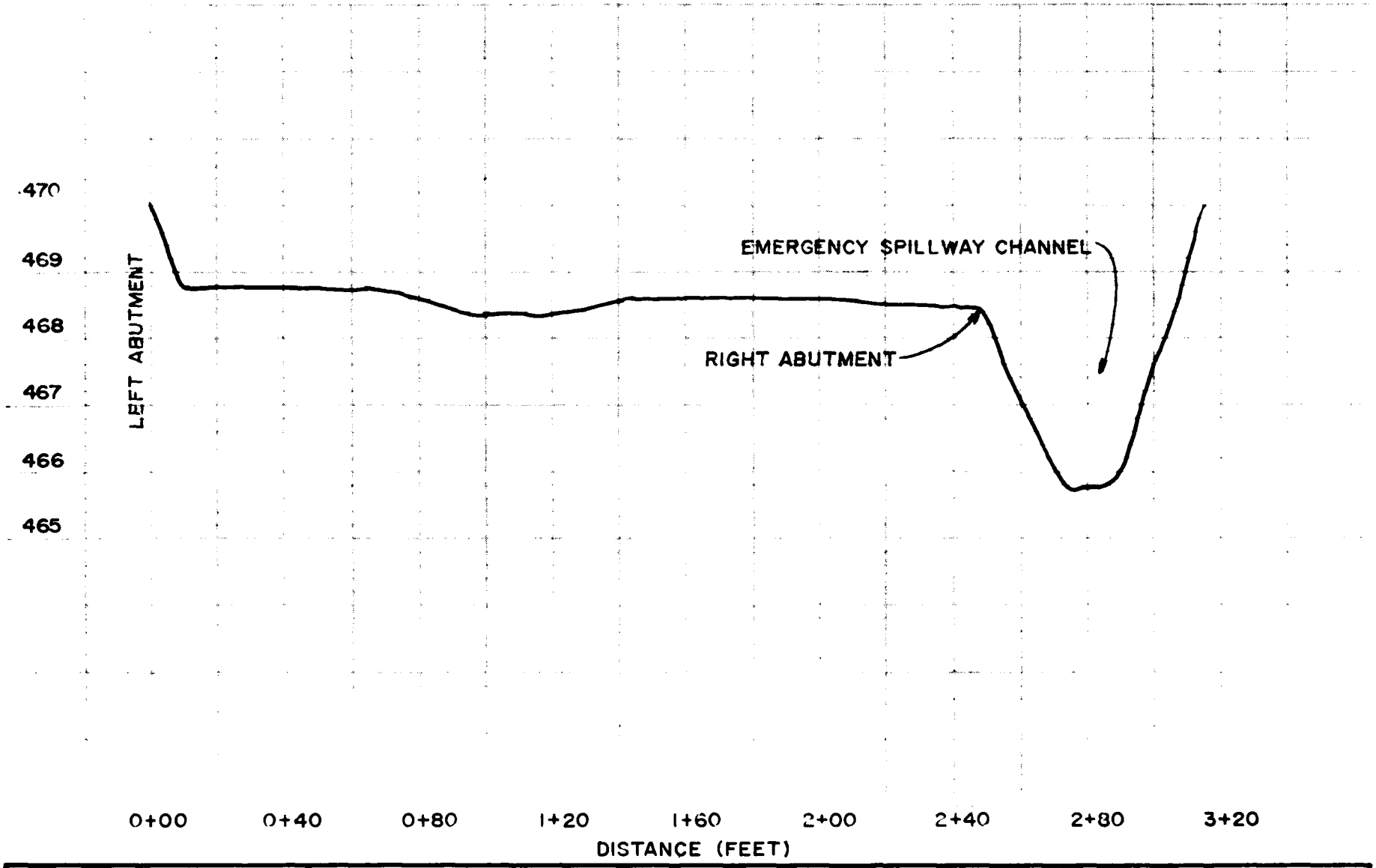
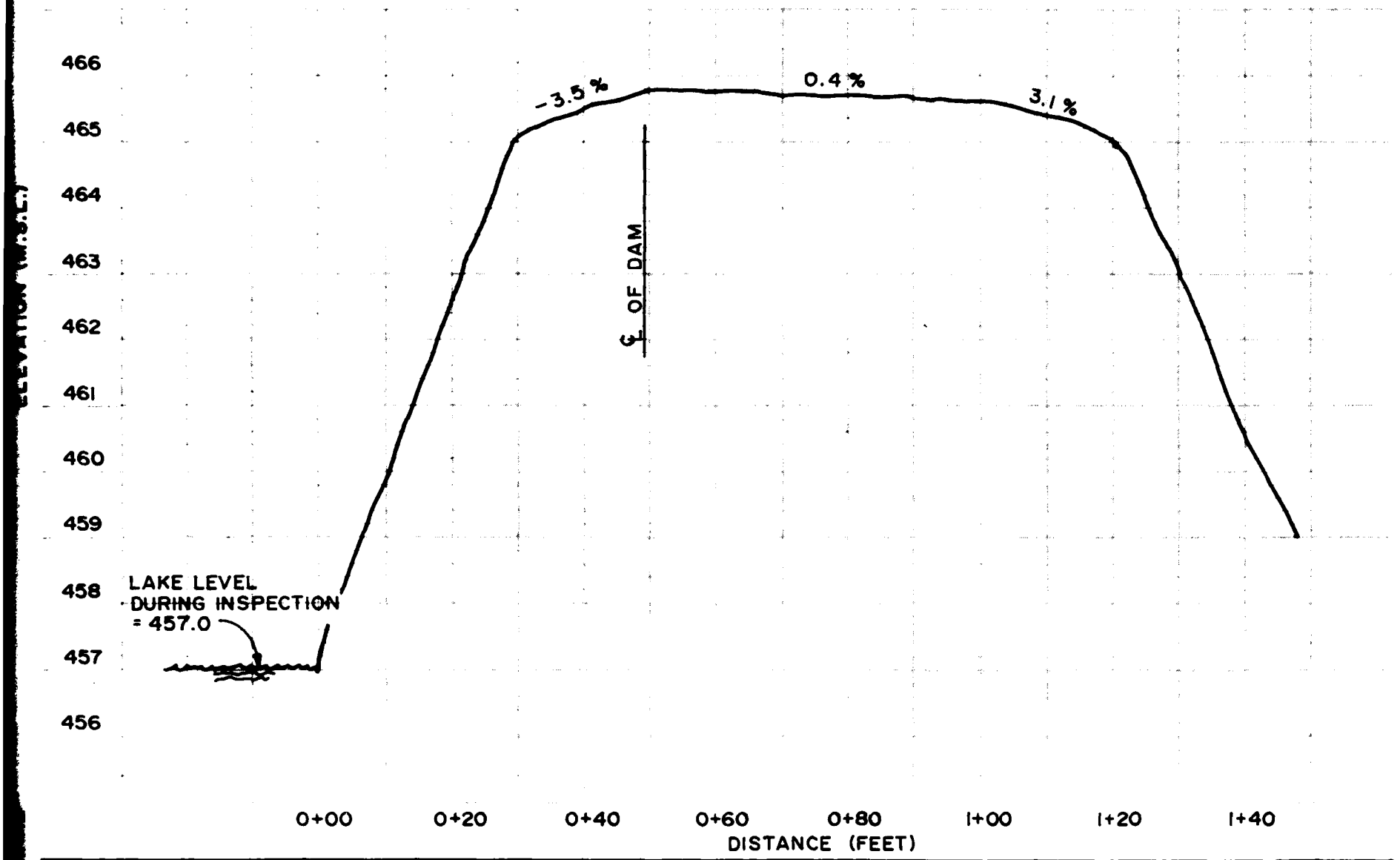
ELEVATION - AREA - CAPACITY RELATION
LAUCK LAKE DAM MO40068



CLAYPOOLE HUDSPETH & TILLEY, Inc. Consulting Engineers SPRINGFIELD, IL • LINCOLN, IL • AURORA, IL	U.S. ARMY ENGINEER DISTRICT, ST. LOUIS CORPS OF ENGINEERS NATIONAL DAM SAFETY PROGRAM	PROFILE OF DAM CREST LAUCK LAKE DAM MO 40068



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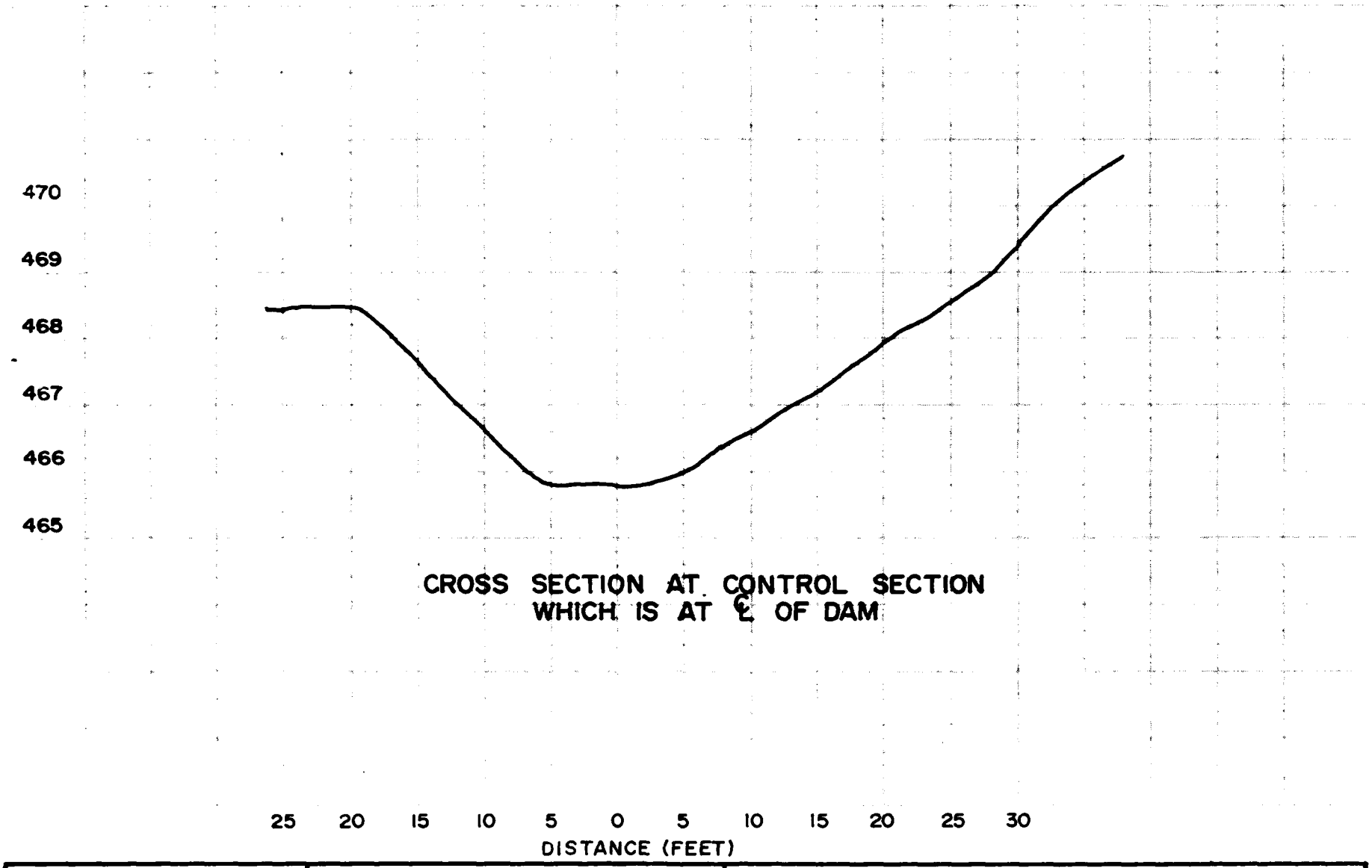
EMERGENCY SPILLWAY FLOWLINE PROFILE
LAUCK LAKE DAM M040068

EXHIBIT 5



CROSS SECTION AT CONTROL SECTION
WHICH IS AT ℄ OF DAM

CRAWFORD, MURPHY & TILLY, inc. Consulting Engineers SPRINGFIELD, IL • LINCOLN, IL • AURORA, IL	U.S. ARMY ENGINEER DISTRICT, ST. LOUIS CORPS OF ENGINEERS NATIONAL DAM SAFETY PROGRAM	EMERGENCY SPILLWAY CROSS SECTION LAUCK LAKE DAM MO40068

CM&T

U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
NATIONAL DAM SAFETY PROGRAM

INPUT DATA
LAUCK LAKE DAM MO40068

```
A1 HYDROLOGIC/HYDRAULIC ANALYSIS -- LAUCK LAKE DAM(MO 40068), SCOTT COUNTY, MO.
A2 NATIONAL DAM SAFETY PROGRAM -- CORPS OF ENGINEERS, ST. LOUIS DISTRICT
A3 CM&T JOB NO. 8034-02                              JANUARY 16, 1981
B     288        0        5                                    0        0       -2
B1      5
J       1        6        1
J1   0.20     0.25     0.40     0.45     0.50      1.0
K       0  INFLOW                                             1
K1 INFLOW HYDROGRAPH COMPUTATION
M       1        2    0.055                                1                1
P       0     27.0      102      120      130
T                                                          -1      -83             0.14
W2           0.032
X       0     -.1     1.75
K       1     LAKE                                         1
K1 RESERVOIR ROUTING BY MODIFIED PULS METHOD
Y                                      1        1
Y1      1                                             -464.3       -1
Y4 464.0    464.5    465.0    465.8    466.3    466.8    467.3    467.8    468.3    468.8
Y4 469.3    469.8
Y5      0      0.7      1.0      1.4        6       22       62      122      214      342
Y5    518      708
$A      0      0.5      1.3      2.2      3.2      4.4      6.1
$I    440      445      450      455      460      465      470
$$    464
$D 468.3      2.6      1.5      250
$L     20       35       65      170      240      245      250
$V 468.3    468.4    468.5    468.6    468.7    469.4    470.1
K      99
A
```

HYDROGRAPH AT STAINFLOW FOR PLAN 1, RTIO 4

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	5.	7.	7.	8.	8.	8.	8.	8.
9.	9.	9.	9.	9.	9.	9.	10.	10.	10.
10.	10.	10.	10.	10.	10.	10.	11.	11.	11.
11.	11.	11.	11.	11.	11.	11.	11.	11.	11.
11.	11.	11.	11.	11.	11.	11.	12.	12.	12.
12.	12.	12.	12.	12.	12.	12.	12.	12.	12.
12.	12.	12.	12.	12.	12.	12.	12.	12.	12.
12.	12.	12.	12.	34.	40.	41.	42.	42.	42.
42.	42.	42.	42.	42.	42.	49.	51.	51.	51.
51.	51.	51.	52.	52.	52.	52.	52.	61.	64.
65.	65.	65.	65.	65.	65.	65.	65.	65.	65.
46.	70.	78.	109.	132.	286.	491.	294.	175.	131.
98.	82.	66.	62.	61.	61.	61.	61.	61.	61.
61.	61.	61.	61.	52.	49.	48.	48.	48.	48.
48.	48.	48.	48.	48.	48.	46.	43.	41.	39.
36.	34.	33.	31.	29.	28.	26.	25.	23.	22.
21.	20.	19.	18.	17.	16.	15.	14.	13.	13.
12.	11.	11.	10.	10.	9.	9.	8.	8.	7.
7.	6.	6.	6.	5.	5.	5.	5.	4.	4.
4.	4.	4.	4.	4.	4.	4.	4.	4.	4.
4.	4.	4.	4.	4.	4.	4.	4.	4.	4.
4.	4.	4.	4.	4.	4.	4.	4.		

STATION LAKE, PLAN 1, RATIO 4

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
2.	2.	3.	3.	4.	4.	5.	5.	6.	8.
10.	12.	13.	15.	17.	18.	20.	21.	23.	27.
31.	35.	38.	41.	43.	45.	47.	49.	51.	52.
53.	53.	55.	59.	67.	88.	136.	190.	199.	190.
173.	155.	138.	122.	113.	106.	99.	94.	89.	85.
82.	79.	76.	74.	71.	68.	65.	63.	61.	60.
59.	58.	57.	56.	55.	54.	54.	53.	52.	50.
49.	48.	46.	45.	43.	42.	40.	39.	37.	36.
34.	33.	31.	30.	29.	27.	26.	25.	24.	23.
22.	21.	21.	20.	20.	20.	19.	19.	18.	18.
17.	17.	16.	16.	15.	15.	14.	14.	14.	13.
13.	12.	12.	12.	11.	11.	11.	11.	10.	10.
10.	10.	9.	9.	9.	9.	8.	8.	8.	8.
8.	8.	7.	7.	7.	7.	7.	7.		

CMT

U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
NATIONAL DAM SAFETY PROGRAM

INFLOW AND OUTFLOW 45% PMF
LAUCK LAKE DAM MO40068

EXHIBIT 7

HYDROGRAPH AT STAINFLOW FOR PLAN 1, RTIO 5

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	2.	2.	2.	2.	2.
2.	2.	6.	7.	8.	8.	9.	9.	9.	9.
10.	10.	10.	10.	10.	10.	11.	11.	11.	11.
11.	11.	11.	11.	11.	12.	12.	12.	12.	12.
12.	12.	12.	12.	12.	12.	12.	12.	12.	12.
13.	13.	13.	13.	13.	13.	13.	13.	13.	13.
13.	13.	13.	13.	13.	13.	13.	13.	13.	13.
13.	13.	13.	13.	13.	13.	13.	13.	13.	13.
13.	13.	13.	13.	38.	44.	46.	46.	46.	47.
47.	47.	47.	47.	47.	47.	54.	56.	57.	57.
57.	57.	57.	57.	57.	57.	57.	57.	68.	71.
72.	72.	72.	72.	72.	72.	72.	72.	72.	72.
51.	78.	86.	121.	147.	317.	546.	327.	194.	146.
102.	91.	74.	69.	68.	68.	68.	68.	68.	68.
68.	68.	68.	68.	57.	54.	54.	54.	54.	54.
54.	54.	54.	54.	54.	54.	51.	48.	45.	43.
40.	38.	36.	34.	32.	31.	29.	27.	26.	24.
23.	22.	21.	20.	19.	17.	17.	16.	15.	14.
13.	13.	12.	11.	11.	10.	9.	9.	8.	8.
8.	7.	7.	6.	6.	6.	5.	5.	5.	5.
5.	5.	5.	5.	5.	5.	5.	5.	5.	5.
5.	5.	5.	5.	5.	5.	5.	5.	5.	5.
5.	5.	5.	5.	5.	5.	5.	5.		

STATION LAKE, PLAN 1, RATIO 5

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	2.	3.
3.	4.	4.	5.	5.	6.	8.	10.	12.	14.
16.	18.	19.	21.	23.	27.	30.	33.	36.	39.
43.	46.	48.	51.	53.	55.	57.	58.	60.	61.
61.	61.	64.	70.	79.	102.	162.	221.	233.	215.
196.	175.	155.	138.	123.	115.	108.	102.	97.	93.
89.	86.	84.	81.	79.	75.	72.	69.	67.	65.
63.	62.	61.	60.	60.	59.	58.	57.	56.	55.
54.	52.	51.	49.	48.	46.	44.	43.	41.	39.
38.	36.	35.	33.	32.	30.	29.	28.	26.	25.
24.	23.	22.	21.	21.	20.	20.	20.	19.	19.
18.	18.	17.	17.	16.	16.	15.	15.	14.	14.
14.	13.	13.	13.	12.	12.	12.	11.	11.	11.
10.	10.	10.	10.	9.	9.	9.	9.	9.	9.
8.	8.	8.	8.	8.	8.	8.	7.		

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EXHIBIT 8

HYDROGRAPH AT STAINFLOW FOR PLAN 1, RTIO 6

1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	3.	3.	3.	3.	3.	3.	3.
3.	3.	3.	3.	3.	3.	3.	3.	3.	3.
3.	3.	12.	15.	16.	17.	17.	18.	18.	19.
19.	19.	20.	20.	20.	21.	21.	21.	22.	22.
22.	22.	23.	23.	23.	23.	23.	23.	24.	24.
24.	24.	24.	24.	24.	25.	25.	25.	25.	25.
25.	25.	25.	25.	25.	25.	26.	26.	26.	26.
26.	26.	26.	26.	26.	26.	26.	26.	26.	26.
26.	26.	26.	27.	27.	27.	27.	27.	27.	27.
27.	27.	27.	27.	75.	89.	92.	93.	93.	93.
93.	94.	94.	94.	94.	94.	108.	113.	114.	114.
114.	114.	114.	114.	115.	115.	115.	115.	136.	142.
144.	144.	144.	144.	144.	145.	145.	145.	145.	145.
103.	156.	172.	241.	293.	635.	1092.	653.	389.	292.
204.	182.	147.	138.	137.	136.	136.	136.	136.	136.
136.	136.	136.	136.	115.	109.	107.	107.	107.	107.
107.	107.	107.	107.	107.	107.	101.	96.	91.	86.
81.	77.	72.	68.	65.	61.	58.	55.	52.	49.
46.	44.	41.	39.	37.	35.	33.	31.	30.	28.
26.	25.	24.	22.	21.	20.	19.	18.	17.	16.
15.	14.	14.	13.	12.	11.	11.	10.	10.	10.
10.	10.	10.	10.	10.	10.	10.	10.	10.	10.
10.	10.	10.	10.	10.	10.	10.	10.	10.	10.
10.	10.	10.	10.	10.	10.	10.	10.		

STATION LAKE, PLAN 1, RATIO 6

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	2.	2.	2.	3.	3.
3.	4.	4.	4.	5.	5.	5.	5.	6.	6.
7.	7.	8.	9.	10.	11.	11.	12.	13.	13.
14.	14.	15.	15.	17.	20.	24.	31.	38.	43.
48.	53.	57.	61.	65.	70.	74.	80.	85.	89.
92.	96.	98.	101.	103.	104.	106.	107.	110.	114.
118.	122.	126.	130.	133.	136.	137.	139.	140.	141.
137.	136.	142.	156.	179	249.	606.	823.	578.	407.
318.	268.	234.	209.	194.	180.	173.	165.	159.	154.
151.	148.	145.	143.	140.	134.	128.	124.	121.	119.
117.	116.	115.	114.	113.	112.	111.	109.	107.	104.
101.	98.	94.	91.	87.	84.	80.	77.	73.	70.
67.	63.	61.	59.	57.	55.	52.	50.	48.	46.
44.	42.	41.	39.	37.	35.	34.	32.	31.	29.
28.	26.	25.	24.	23.	22.	21.	21.	20.	20.
19.	19.	19.	18.	18.	17.	17.	17.	17.	16.
16.	16.	15.	15.	15.	15.	14.	14.	14.	14.
14.	13.	13.	13.	13.	13.	13.	13.		

U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
NATIONAL DAM SAFETY PROGRAM

INFLOW AND OUTFLOW 100% PMF
LAUCK LAKE DAM MO40068

EXHIBIT 9

CM&T

U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
NATIONAL DAM SAFETY PROGRAM

SUMMARY TABLE
LAUCK LAKE DAM MO40068

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .20	RATIO 2 .25	RATIO 3 .40	RATIO 4 .45	RATIO 5 .50	RATIO 6 1.00
HYDROGRAPH AT	INFLOW	.06	1	218.	273.	437.	491.	546.	1092.
		(.14)	(	6.18)(	7.73)(	12.37)(	13.91)(	15.46)(	30.91)(
ROUTED TO	LAKE	.06	1	34.	66.	168.	199.	233.	823.
		(.14)	(	.96)(	1.86)(	4.76)(	5.64)(	6.60)(	23.31)(

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	464.30	464.00	468.30
STORAGE	43.	42.	62.
OUTFLOW	0.	0.	214.

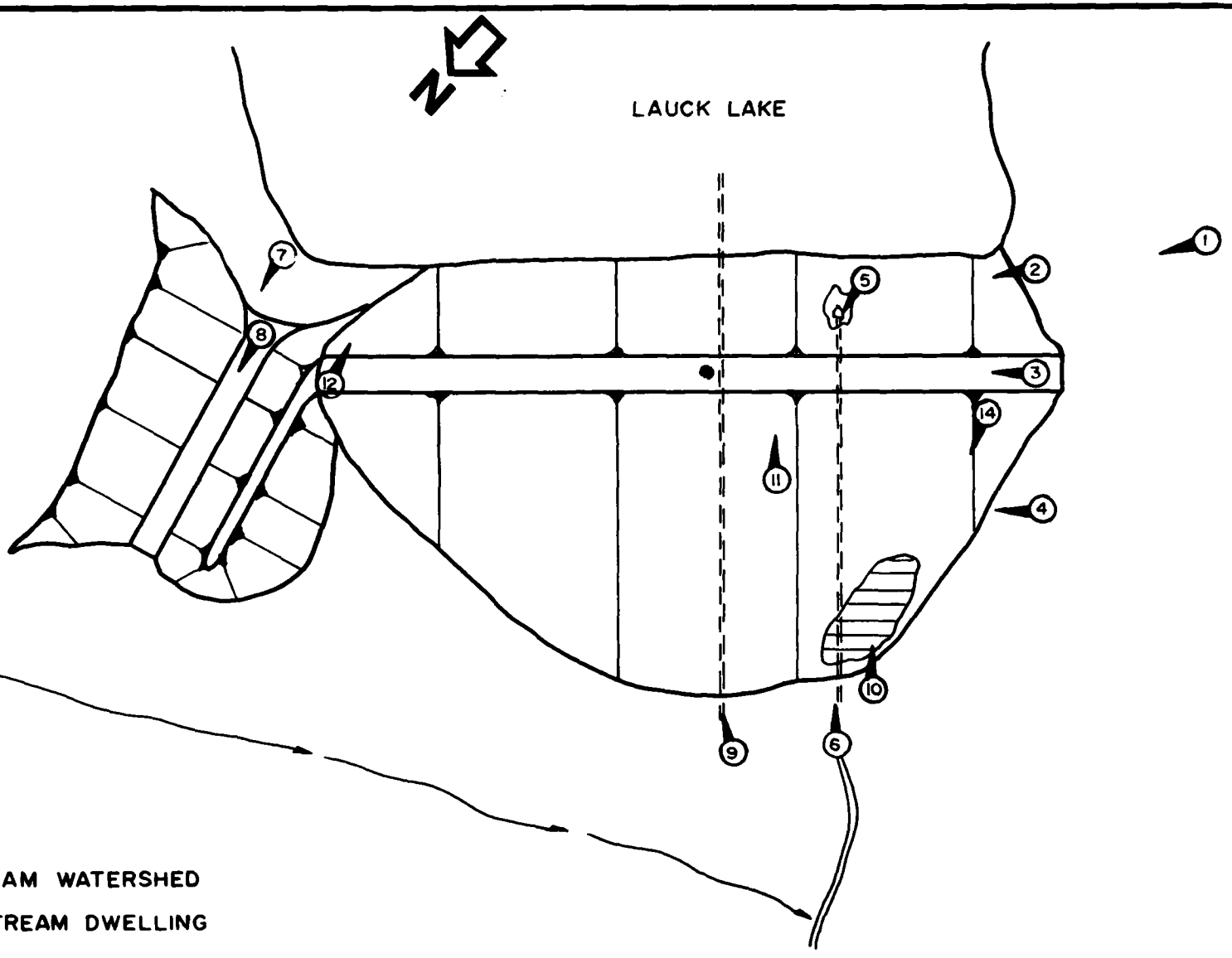
RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.20	466.95	0.00	55.	34.	0.00	16.00	0.00
.25	467.33	0.00	57.	66.	0.00	15.83	0.00
.40	468.05	0.00	61.	168.	0.00	15.75	0.00
.45	468.22	0.00	62.	199.	0.00	15.75	0.00
.50	468.37	.07	63.	233.	.25	15.75	0.00
1.00	469.15	.85	67.	823.	.67	15.67	0.00

EXHIBIT 10

PHASE I INSPECTION REPORT

APPENDIX C

PHOTOGRAPHS



CRAWFORD, MURPHY & TILLY, inc. Consulting Engineers SPRINGFIELD, IL • LINCOLN, IL • AURORA, IL	U.S. ARMY ENGINEER DISTRICT, ST. LOUIS CORPS OF ENGINEERS NATIONAL DAM SAFETY PROGRAM	PHOTOGRAPH INDEX LAUCK LAKE DAM MO40068

Photograph 2. Upstream slope of dam viewed from the left abutment.

Photograph 3. Crest of dam viewed from the left abutment.

Photograph 4. Downstream slope of dam viewed from the left abutment.

Photograph 5. Intake end of principal spillway.

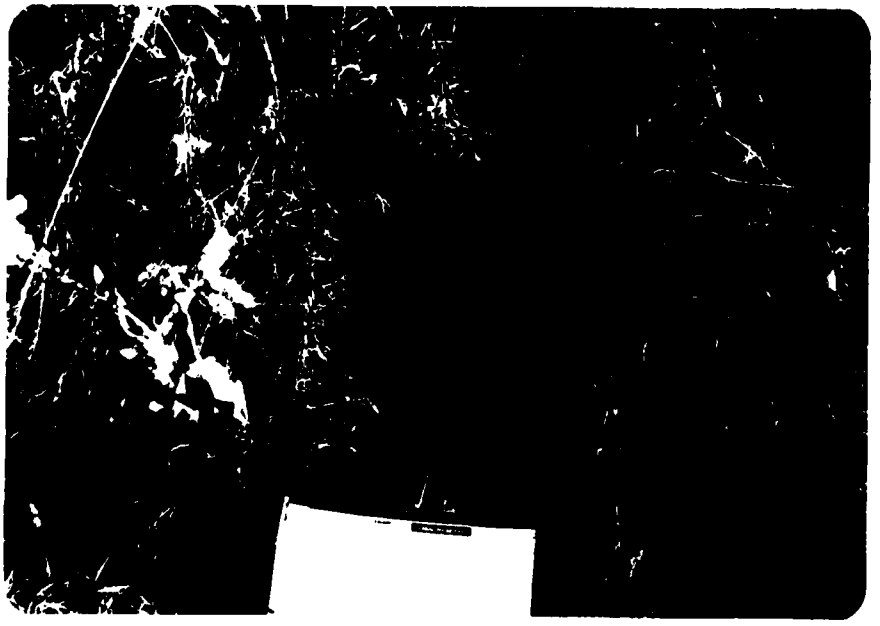
Photograph 6. Downstream end of principal spillway. Note that the end of the pipe is buried in silt.

Photograph 7. Emergency spillway approach channel looking from the lake shoreline.

Photograph 8. Emergency spillway channel looking downstream from the crest.

Photograph 9. Downstream end of drawdown facility.

Photograph 10. Typical erosion ditches near toe of dam on the downstream slope.



Photograph 11. Animal burrow on downstream slope of the dam.

Photograph 12. View of lake and surrounding area from the right side of the dam.

Photograph 13. View of watershed with forest on the right and cleared recreational area on the left.

Photograph 14. Downstream channel viewed from dam crest.

Photograph 15. Dwelling located beside downstream channel approximately 0.7 miles downstream from dam.

PHASE I INPECTION REPORT

APPENDIX D

ENGINEERING DESIGN INFORMATION

APPENDIX D

ENGINEERING DESIGN INFORMATION

ENGINEERING GEOLOGIC REPORT ON THE ELK'S CLUB LAKE

SCOTT COUNTY, MISSOURI

LOCATION: SW¼, NW¼, NW¼, Sec. 16, T. 29 N., R. 13 E., Chaffee Quadrangle.

GENERAL SETTING:

The proposed lake site is situated in a steep wooded valley that trends to the northwest and opens onto the Hindman Creek valley approximately ½ mile downstream of the dam site. The valley in which the dam is located has the appearance of a gaining valley. There are numerous large oaks, hickory, and tulip trees in the valley. Soils exposed in the sides of the valley consist of sandy clay containing scattered gravel. Bedrock is not exposed in the valley although there are large boulders of sandstone and cherty sandstone in the creek channel. The floor of the creek is covered with various sized rounded gravel. The creek contained a small flow of water at the time of this examination. This was probably runoff water from drains that occurred the day before.

Plans call for the dam to be 30 feet high with a water depth of 25 feet at the dam site. According to the Soil Conservation Service, this would form a lake of 4½ to 5 acres with a watershed of 35 acres.

CONCLUSION:

From surface appearance this site looks geological suitable for a lake. A cutoff trench should be excavated at the proposed dam site. The trench should be seated into a tight clay or bedrock. The trench should extend up the sides of the valley and gradually feather out as it approaches the lake water line. If the trench is seated in bedrock as much of the weathered bedrock should be removed as possible with the equipment excavating the cutoff trench.

Soil for construction of the dam should come from the valley slope and upper part of the lake basin.

John W. Whitfield

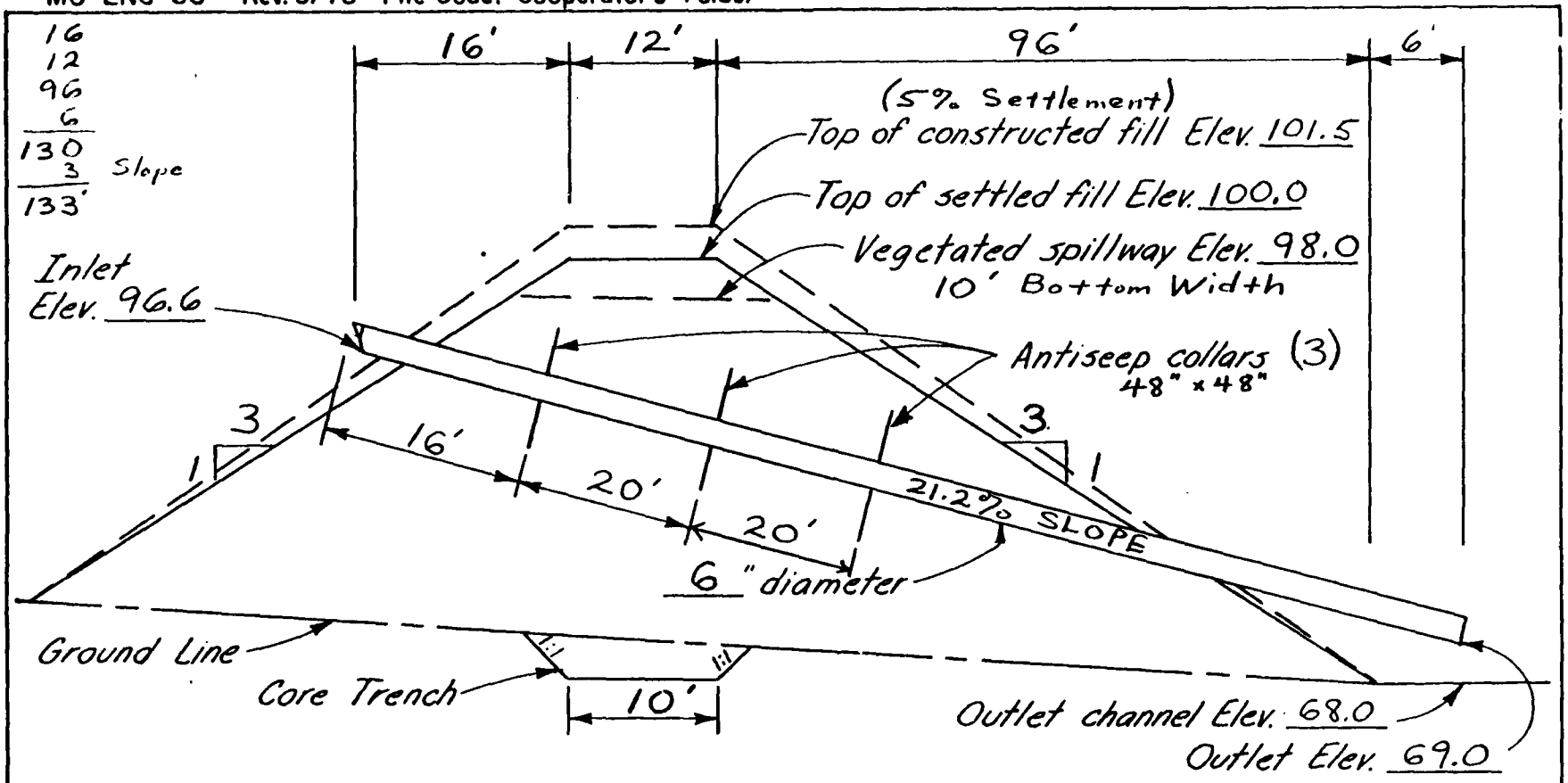
John W. Whitfield, Geologist
Applied Engineering & Urban Geology
Geology & Land Survey
September 23, 1977

orig: Dan Frissel
Dist. Conservationist
Oran State Bank Bldg.
Benton, MO 63736

MO-ENG-66 Rev. 9/75 File Code: Cooperator's Folder

16
12
96
6
130
3
133'

Slope



SECTION ALONG ℄ PRINCIPAL SPILLWAY

Not to Scale

ESTIMATED QUANTITIES

QUAN.	UNIT	ITEM
133	ft	6" SIP - 0.105" Min. Thickness
3		48" x 48" Antiseep Collars
15,230	cu yd	Earth Fill
600	cu yd	Core Trench Excavation (Est.)
1		Trash Rack - Drawing No. 29-N-200

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

~~FLOOD~~ CANOPY

INLET SPILLWAY

Landowner Elks Lodge
Scott County, Missouri
Designed by Greg L. Jarboe Date 9-27-77
Checked by KMM Date 9-28-77
Approved by Kenneth Mirgers Date 9-28-77
Sheet of

MC-ENG-15
Rev. 11-72
File Code: ENG-13

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

EARTHWORK COMPUTATION SHEET FOR EARTH DAM

Landowner or Watershed Elk Lake Location or Sub-watershed Scott County,

Top of Fill: Width 12 feet; Elev. 100.0. Side Slopes: Downstream 3:1; Upstream 3:1

Upstream Berm: Width ____ feet; Elev. ____. Downstream Berm: Width ____ feet; Elev. ____

Computed by Greg Taylor Date 9-27-77 Checked by ____ Date ____

Station	Ground Elev. Ft.	Main Fill		Upstream Berm		Downstream Berm		Total Fill Quantity Cu. Yd. Per ft.	Sum of Fill Quantity Cu. Yd. Per ft.	Distance Between Stations Ft.	Double Fill Quantity Cu. Yd.
		Fill Height Ft.	Fill Quantity Cu. Yd. Per ft.	Fill Height Ft.	Fill Quantity Cu. Yd. Per ft.	Fill Height Ft.	Fill Quantity Cu. Yd. Per ft.				
									XXXXXXXXX	XXXXXXXXX	XXXXXXXXX
0+00	100.0	0	0								
+20	93.3	6.7	8.0						8.0	20	160.0
+40	87.2	12.8	23.9						31.9	20	638.0
+60	81.3	18.7	47.2						71.1	20	1422.0
+80	73.4	26.6	90.5						137.7	20	2754.0
+95	70.0	30.0	113.3						203.8	15	3057.0
1+25	70.0	30.0	113.3						226.6	30	6798.0
+75	76.6	23.4	71.3						184.6	50	9230.0
2+00	80.7	19.3	50.0						121.3	25	3032.5
+25	85.9	14.1	28.4						78.4	25	1960.0
+50	91.3	8.7	12.3						40.7	25	1017.5
+75	96.8	3.2	2.6						14.9	25	372.5
+76	97.0	3.0	2.3						4.9	1	4.9
2+82	98.0	0	0						2.3	6	13.8
Aux. 4' Depth, 10' BW, 1:1 SS											
$\frac{(0+2.4)}{2} \times \frac{4}{27} = 2.07$ cu yd/ft											
									XXXXXXXXXXXXXXXXXXXXXXXXXXXX		

2.1 × 282 = 592 cu yd (estimate) Total Double Fill Quantity 30460.2

Fill Quantity 15230 cu yd

Allow 5 % for Settlement. . . . . —

Side Spillway Fill (Including Dikes). . ____

Backfill for Core Trench Excavation . . 600 cu yd

Backfill for Structure Excavation . . . ____

Backfill for Stripping. . . . . ____

Total Fill Quantity (Class ____) . . . ____

5,L-30,884

U.S. Government Printing Office 1975 — 668-719/40, Region No. 6

MO-ENG-40
Rev. 6/73
File Code: ENG-13

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

DESIGN SHEET FOR CLASS II, III, IV * DETENTION STORAGE STRUCTURE
WITH DROP INLET SPILLWAY -- HOOD INLET SPILLWAY -- CANOPY INLET SPILLWAY *

Landowner Elks Lodge County ~~Cape G.~~ Scott

Design by Greg L. Tabb Date 9-27-77 Checked by _____ Date _____

Drainage area = 36 ac. Height x storage = _____ x _____ = _____

WATERSHED CONDITIONS AND FACTORS

Location factor:	L = 1.0
Infiltration factor: (above) (average) (below) *	I = 1.0
Topographic factor: 13-15 % average slope	T = 1.2
Shape factor: runoff distance = 1400 ft.	S = 1.1
Cover factor: ~~cropland~~ lake 10 %, pasture 10 %, timber 80 %	V = 0.7
Contouring factor:	C = 1.0
Storage factor: _____ % terraced	P = 1.0
	0.92

PEAK RATE OF RUNOFF AND VOLUME OF RUNOFF

Product of factors = L x I x T x S x V x C x P = 0.9 Q_{10} = 98 c.f.s.

V x I = 0.7 x 1.0 = 0.7

For Principal Spillway Design:

25-year peak rate of runoff = Q_{ip} = 1.3 x 98 c.f.s. = 127 c.f.s.

Rate of volume of runoff = .14 ac. ft./ac. (Table 1, 1519)

Total volume of runoff = V_{rp} = (drainage area) x (rate of volume of runoff) x L =

36 ac. x .14 ac. ft./ac. x 1.0 = 5.04 ac. ft.

For Both Spillways (Total Structure):

50-year peak rate of runoff = Q_i = 1.5 x 98 c.f.s. = 147 c.f.s.

Rate of volume of runoff = .17 ac. ft./ac.

Total volume of runoff = V_r = 36 ac. x .17 ac. ft./ac. x 1.0 = 6.12 ac.ft.

*Mark out those items that do not apply.

Instructions for use of form: Make one pencil copy for applicable structure. File with other worksheets and structure plan in landowner's folder in field office.

USDA-SCS LINCOLN NEBR. 1973

5,L-32,175-1(2)

WL 76.6
EC
1'Flow
Top 100.0

PRINCIPAL SPILLWAY DESIGN

Available storage at stage of 1.4 ft. = V_{sp} = 5.10 ac. ft. (See map)

$V_{sp} \div V_{rp}$ = 5.10 ac. ft. ÷ 5.04 ac. ft. = 1.01. $Q_{op} \div Q_{ip}$ = 0 (Table 2, 1519)

Q_{op} = ____ c.f.s. x 0 = 0 c.f.s.

Conduit:

Type SIP Length = ____ ft. Total head on conduit = ____ ft.

Diameter = 6 in. Discharge capacity = ____ c.f.s. (1520)

Minimum entrance head = 0.75 ft. (1510 or 1511)

Riser: **

Type ____ Height = ____ ft. Diameter = ____ in. (1511)

EMERGENCY SPILLWAY DESIGN

Control Section:

Depth of flow = 1.0 ft. V_s at this depth = 8.74+ ac. ft. (See map)

$V_s \div V_r$ = 8.74 ac. ft. ÷ 6.12 ac. ft. = 1.43

$Q_{op} \div Q_i$ = ____ c.f.s. ÷ ____ c.f.s. = 0. $Q_{oe} \div Q_i$ = 0 (Table 3, 1519)

Q_{oe} = 147 c.f.s. x 0 = 0 c.f.s.

Width = 10 ft. Total depth = depth of flow + freeboard = 1.0 ft. + 1.0 = 2.0 ft. Use 2.0 ft. (Table 4, 1517)

Exit Section:

Slope = ____ % Quality of vegetation: ~~(fair)~~ ~~(good)~~ (excellent) *

(Less) (More) * erosive soils. Permissible velocity = ____ f.p.s. (1517)

Depth = ____ ft. Design velocity = ____ f.p.s. Width = ____ ft. (1517 or 1505)

Use width of ____ ft.

ANTI-SEEP COLLARS

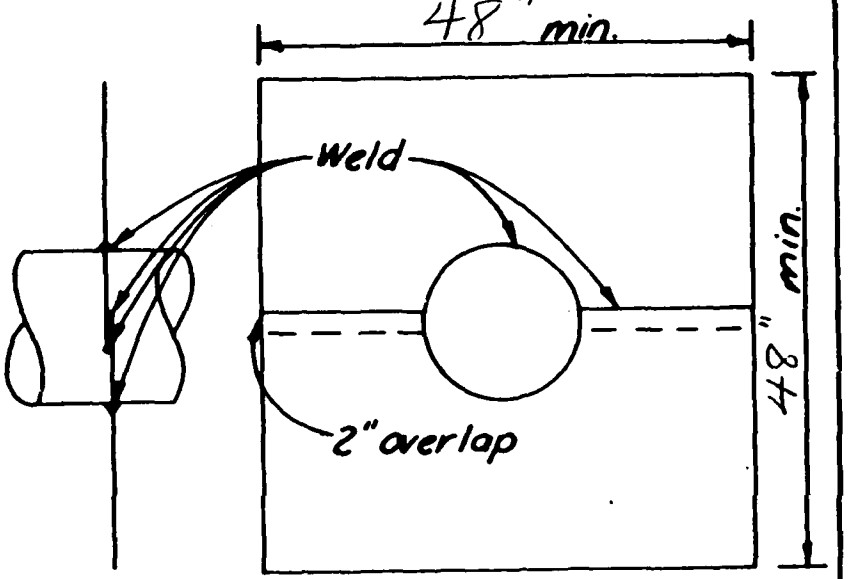
Length of saturated zone = L = ____ ft. Collar addition = 8.1 ft. (1515)

Number = n = (L x 15%) ÷ V = (8.1 x .1) ÷ 3.5 = 2.3. Use 3 collars.

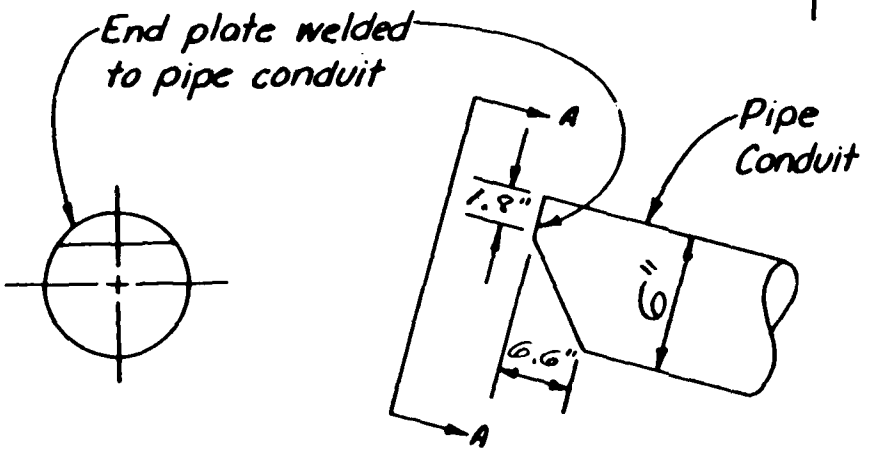
* Mark out those items that do not apply.
** Applies only to Drop Inlet Spillways.

Notes:

1. All welds shall be watertight.
2. All pipe shall have a minimum thickness of 0.105 inches.
3. All steel plates shall have a minimum thickness of .105 inches.



3 ANTI-SEEP COLLARS



SECTION A-A

SECTION ALONG ℄ OF INLET

INLET SECTION

Not to Scale

Elk Lodge Lake

DETAILS OF WELDED STEEL PIPE CANOPY INLET SPILLWAY

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed GLR	Date 9-11	Approved by	
Drawn		Title	
Traced		Title	
Checked		Sheet No.	Drawing No.

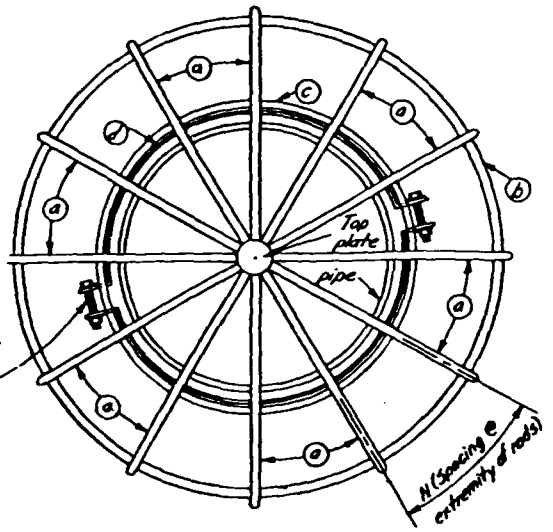
20 1-112

TABLE

PIPE O.D.	APPROX WEIGHT	ⓐ ROD SIZE	H	R	X	O	TOTAL LENGTH	NUMBER REQ'D.	
IN.	LBS.	IN.	IN.	IN.	IN.	IN.	IN.		
6	18.9	3/8	9	4	6	9½	33	10	5
8	22.3	3/8	11	4½	6	10½	39	10	6
10	24.7	3/8	13	5½	6	11½	42	10	
12	27.1	3/8	15	5½	6	12½	45	10	7
14	48.4	1/2	17	6	6	14	48	10	8
16	52.4	1/2	19	6½	6	15	51	10	8
18	69.5	1/2	22	8½	9	19½	60	12	9
20	112.4	5/8	25	9	9	20½	66	12	1
22	118.1	5/8	28	10	9	22	69	12	K
24	124.6	5/8	30	10½	9	23	72	12	1

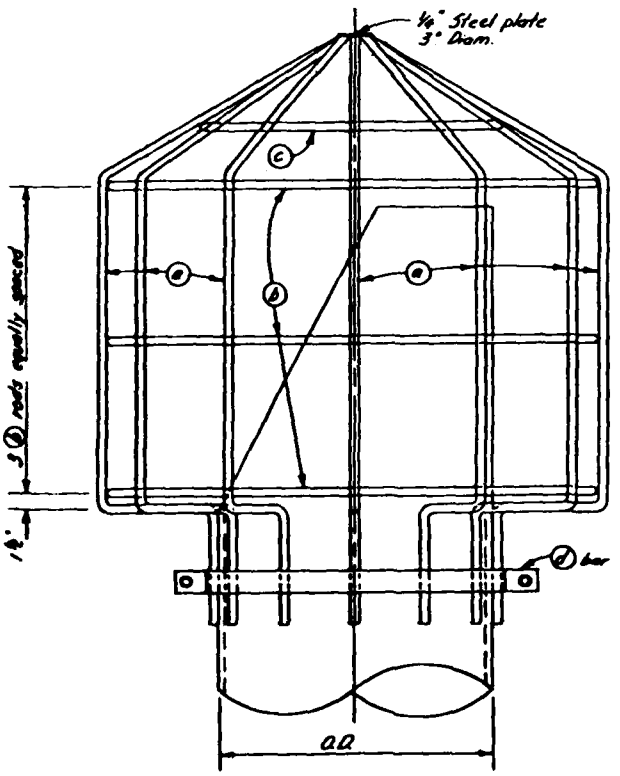
Use This →

NOTE: WELD ⓑ AND ⓒ RODS AND ⓓ BARS TO ⓐ RODS
ⓐ RODS TO TOP PLATE.

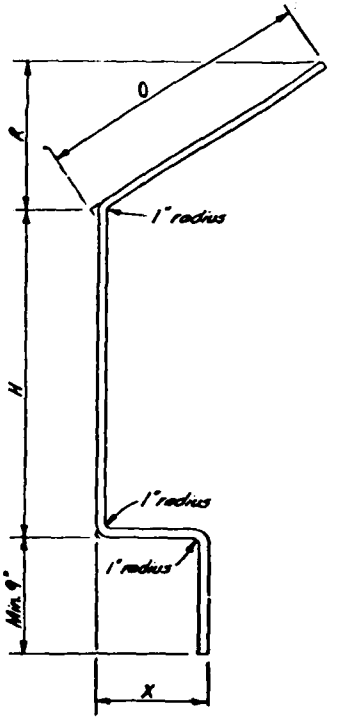


Machine bolt with hex nut and plain washers 4/8" dia. - 2½" long (2 Req'd)

PLAN



ELEVATION



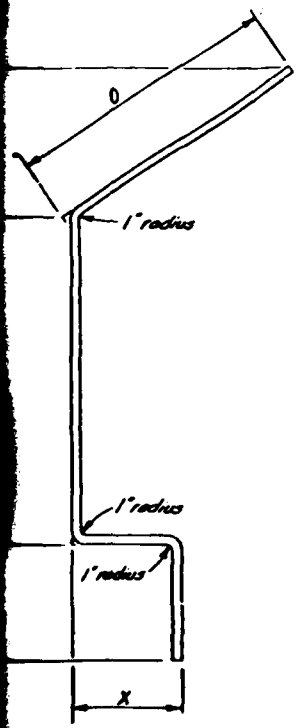
BENDING DIAGRAM FOR ⓐ RODS

TABLE OF DIMENSIONS AND QUANTITIES

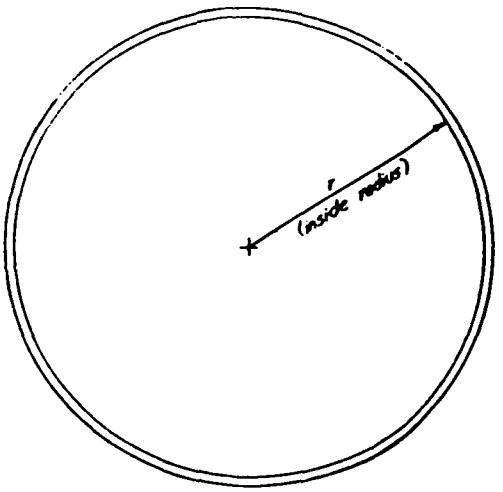
PROX. WEIGHT	ⓐ ROD SIZE	H	R	X	O	TOTAL LENGTH	NUMBER REQ'D.	N	ⓑ ROD SIZE	r	LENGTH	NUMBER REQ'D.	ⓒ ROD SIZE	r	LENGTH	NUMBER REQ'D.	ⓓ BAR SIZE	r	LENGTH	NUMBER REQ'D.	X*
LBS.	IN.	IN.	IN.	IN.	IN.	IN.		IN.	IN.	IN.	IN.		IN.	IN.	IN.		IN.	IN.	IN.		IN.
1.9	⅜	9	4	6	9½	33	10	5⅜	⅜	8¼	51⅛	3	—	—	—	0	2 x ¼	3⅜	26¼	1	5⅜
2.3	⅜	11	4½	6	10½	39	10	6¼	⅜	9¼	58⅛	3	—	—	—	0	2 x ¼	4⅜	32½	1	5⅜
2.7	⅜	13	5½	6	11½	42	10	7	⅜	10¼	64⅜	3	—	—	—	0	2 x ¼	5⅜	38¾	1	5⅜
3.1	⅜	15	5½	6	12½	45	10	7½	⅜	11¼	70⅝	3	—	—	—	0	2 x ¼	6⅜	45	1	5⅜
3.4	½	17	6	6	14	48	10	8⅛	½	12	75⅜	3	½	5	31⅜	1	2 x ¼	7½	52⅛	1	5⅜
3.4	½	19	6½	6	15	51	10	8¾	½	13	81⅝	3	½	6	37⅝	1	2 x ¼	8½	58⅜	1	5⅜
3.5	½	22	8½	9	19½	60	12	9½	½	17	106¾	3	½	7	44	1	2 x ¼	9½	64⅝	1	8⅜
2.4	⅝	25	9	9	20½	66	12	10	⅝	17¾	111½	3	⅝	8	50¼	1	2 x ¼	10⅜	71¾	1	8⅜
3.1	⅝	28	10	9	22	69	12	10½	⅝	18¾	117¾	3	⅝	8	50¼	1	2 x ¼	11⅜	78	1	8⅜
4.6	⅝	30	10½	9	23	72	12	11	⅝	19¾	124	3	⅝	9⅜	58⅛	1	2 x ¼	12⅜	84⅜	1	8⅜

ELD ⓑ AND ⓒ RODS AND ⓓ BARS TO ⓐ RODS AND WELD
) RODS TO TOP PLATE.

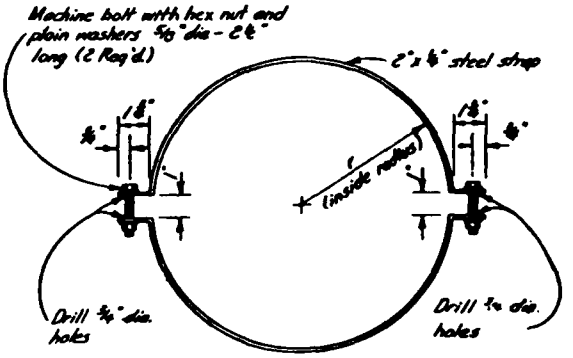
*ALTERNATE DIMENSION FOR USE WITH CORRUGATED METAL PIPE.



DING DIAGRAM FOR
ⓐ RODS



BENDING DIAGRAM FOR
ⓑ AND ⓒ RODS



BENDING DIAGRAM FOR
ⓓ BAR

TRASH RACK FOR CANOPY INLET

Elk Lodge Lake

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

NHR & BES	6-74	Approved: Head, Design Section
BAE	6-74	
B.E.S. & R.W.K.	6-74	

29-N-200